



US010024023B2

(12) **United States Patent**  
**Boyce et al.**

(10) **Patent No.:** **US 10,024,023 B2**  
(45) **Date of Patent:** **Jul. 17, 2018**

(54) **CEMENT FORM APPARATUS AND METHOD**

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(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/698,674**

(22) Filed: **Apr. 28, 2015**

(65) **Prior Publication Data**

US 2016/0319506 A1 Nov. 3, 2016

(51) **Int. Cl.**

**E02D 27/01** (2006.01)

**E04G 17/14** (2006.01)

(52) **U.S. Cl.**

CPC ..... **E02D 27/013** (2013.01); **E02D 27/01** (2013.01); **E02D 27/016** (2013.01); **E04G 17/14** (2013.01)

(58) **Field of Classification Search**

CPC ..... E04G 17/14; E04G 9/05; E01C 19/502; E01C 11/221; E01C 19/506; A01G 1/08  
See application file for complete search history.

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Primary Examiner — Phi D A

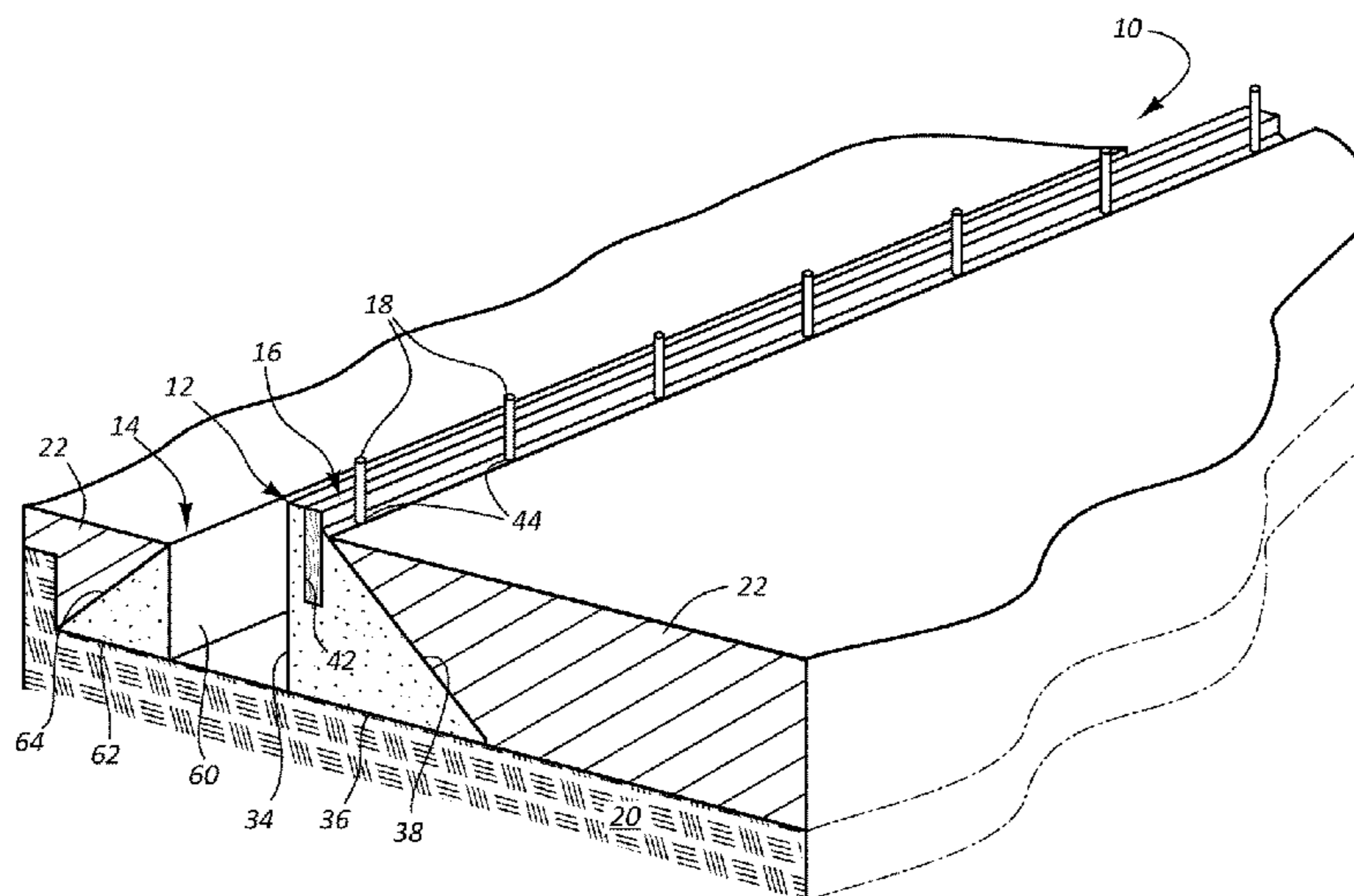
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(57) **ABSTRACT**

A cement form includes a first surface arranged vertically and configured to support a volume of cement, a second surface arranged horizontally and configured to contact a ground support surface. The cement form may include at least one of a foam material and a polymer material. The cement form may include a wedge cross-sectional shape.

**11 Claims, 15 Drawing Sheets**



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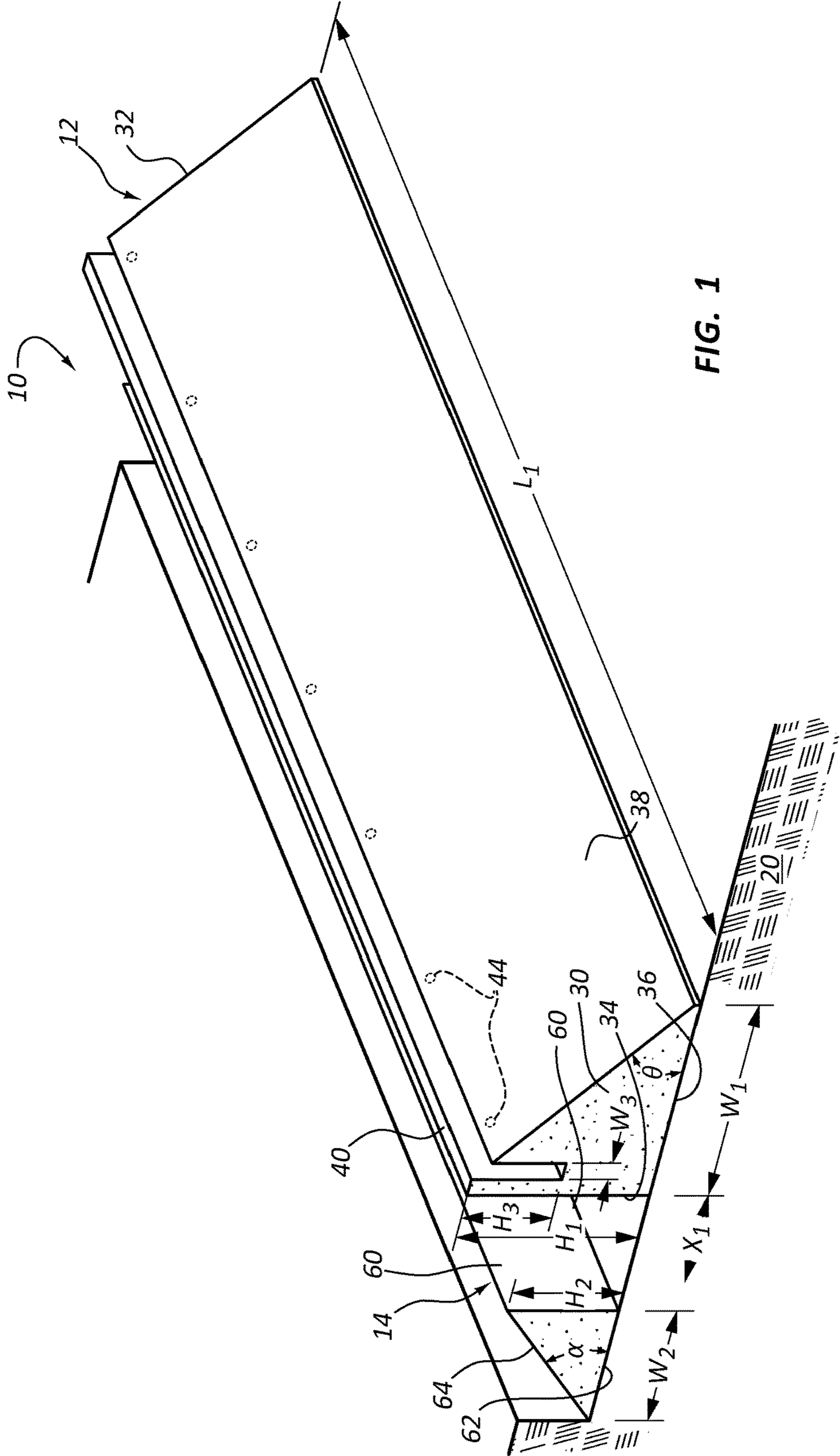


FIG. 1

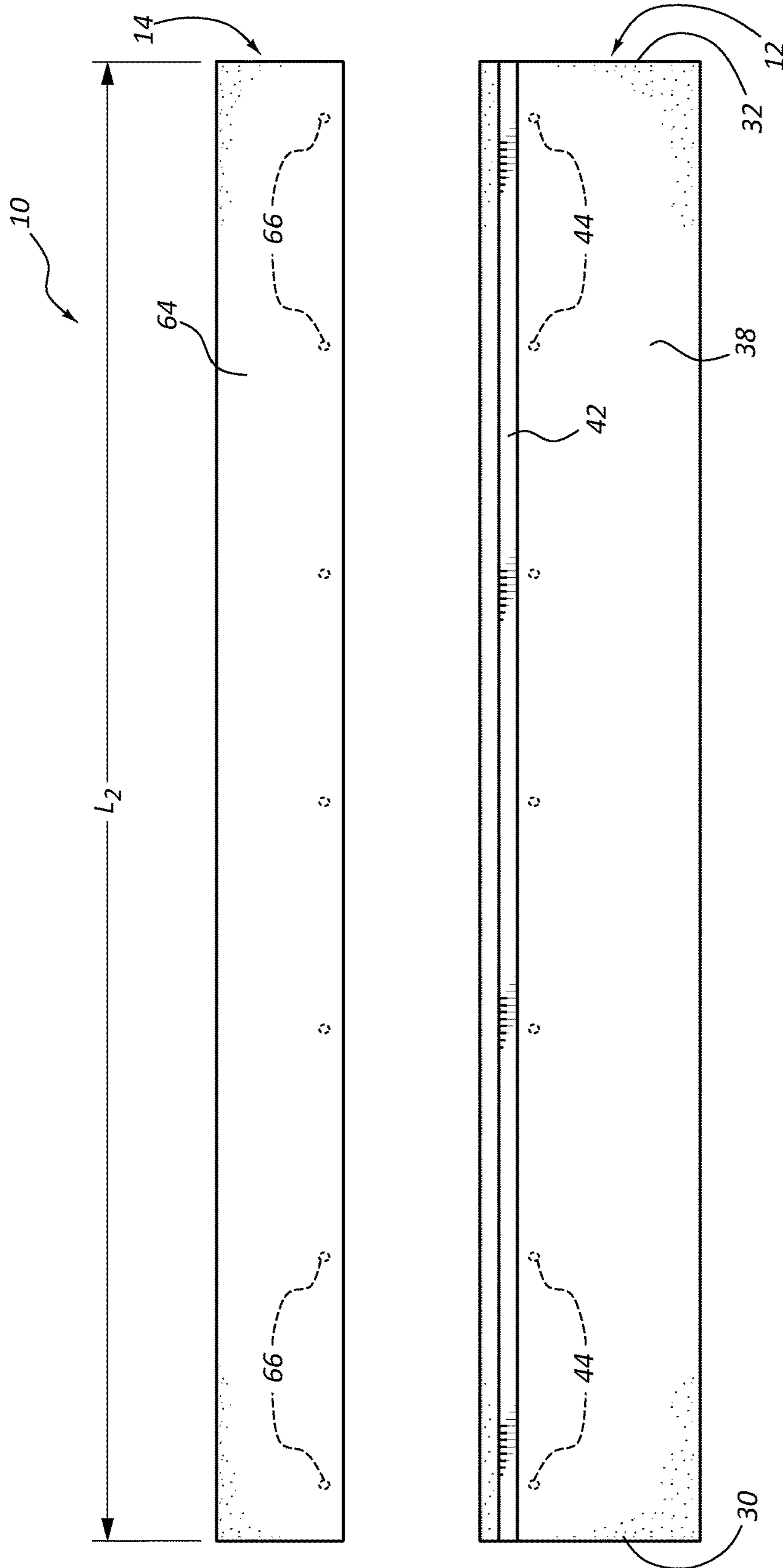


FIG. 1A



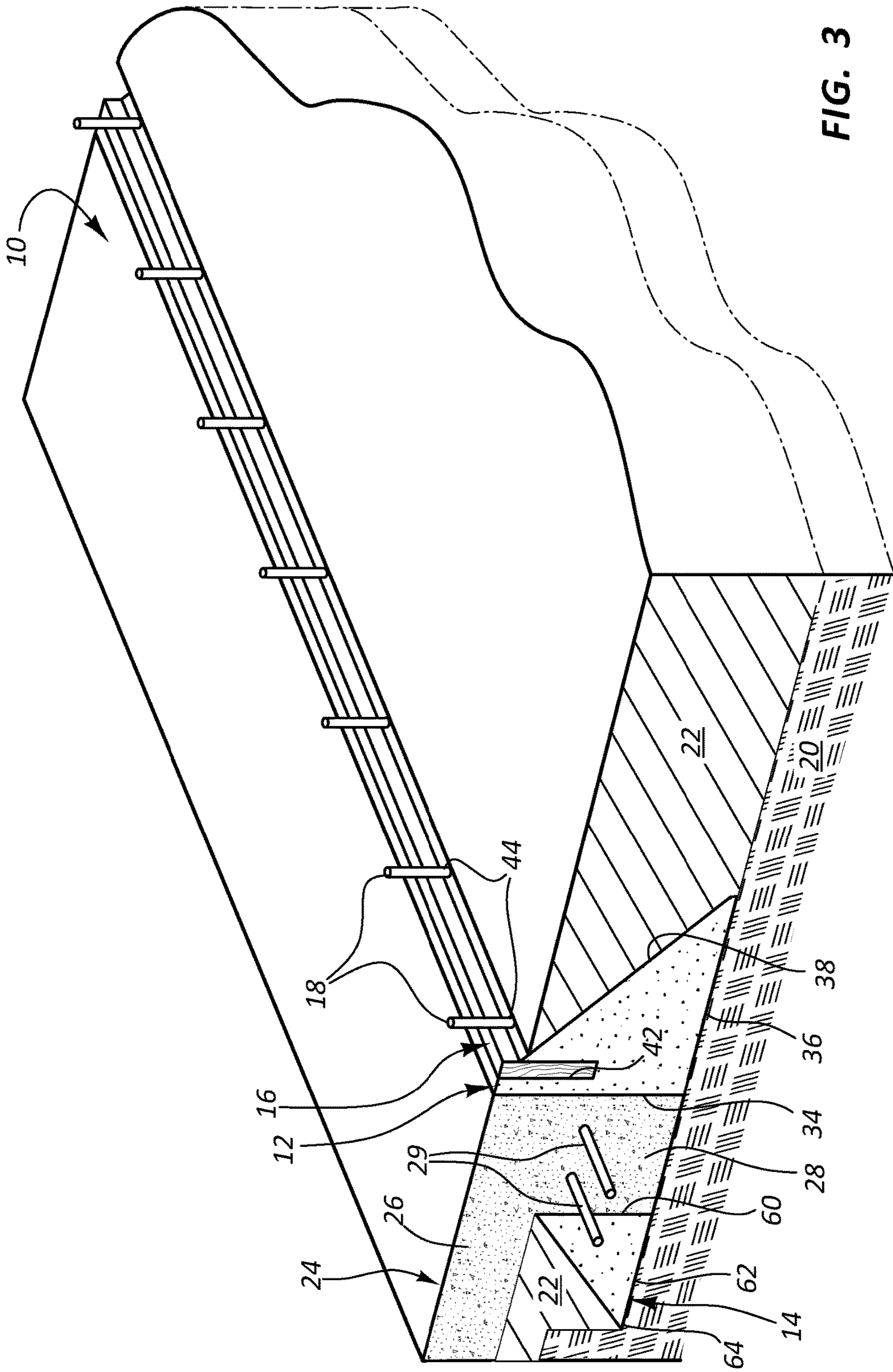


FIG. 3



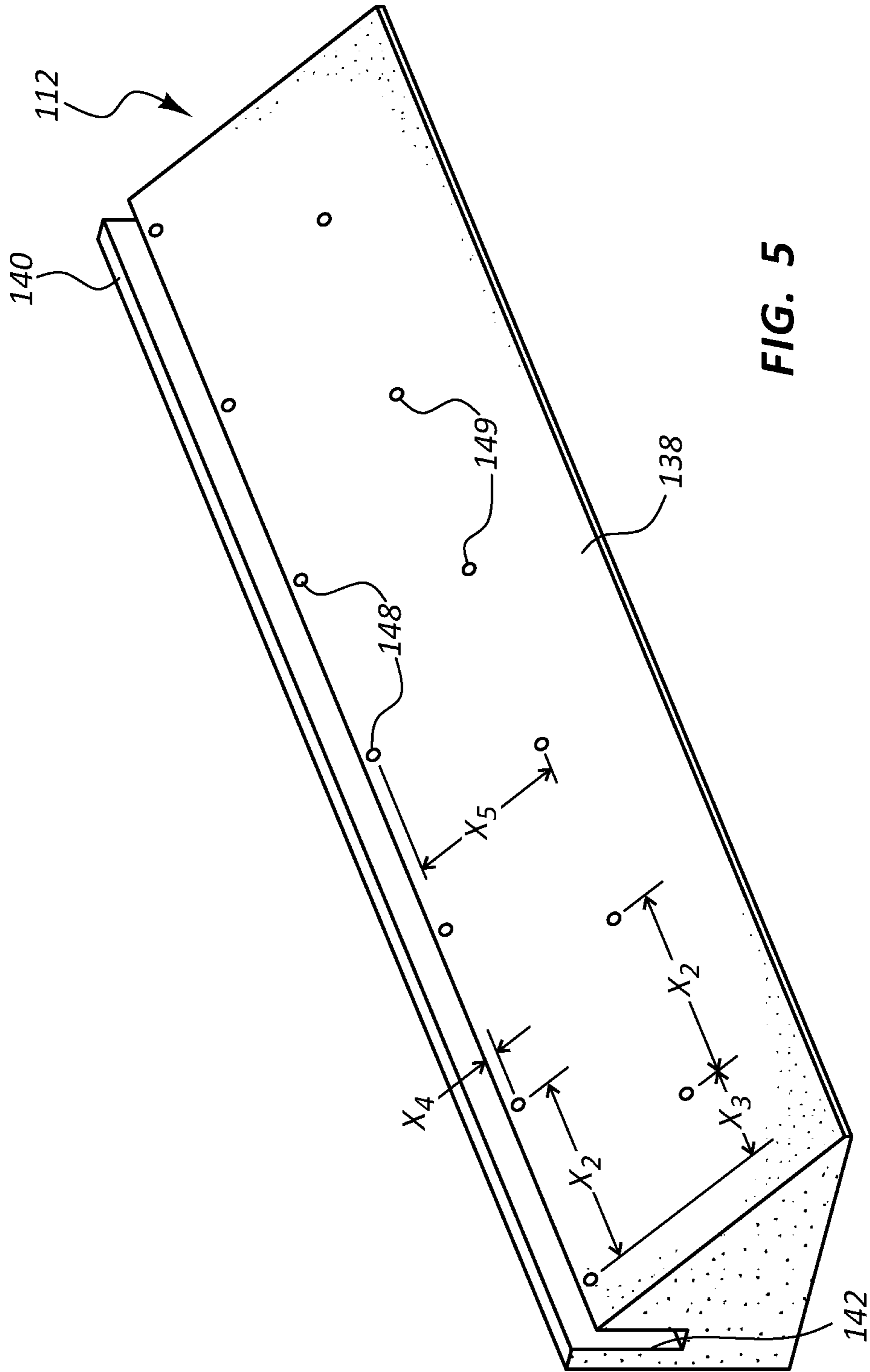


FIG. 5



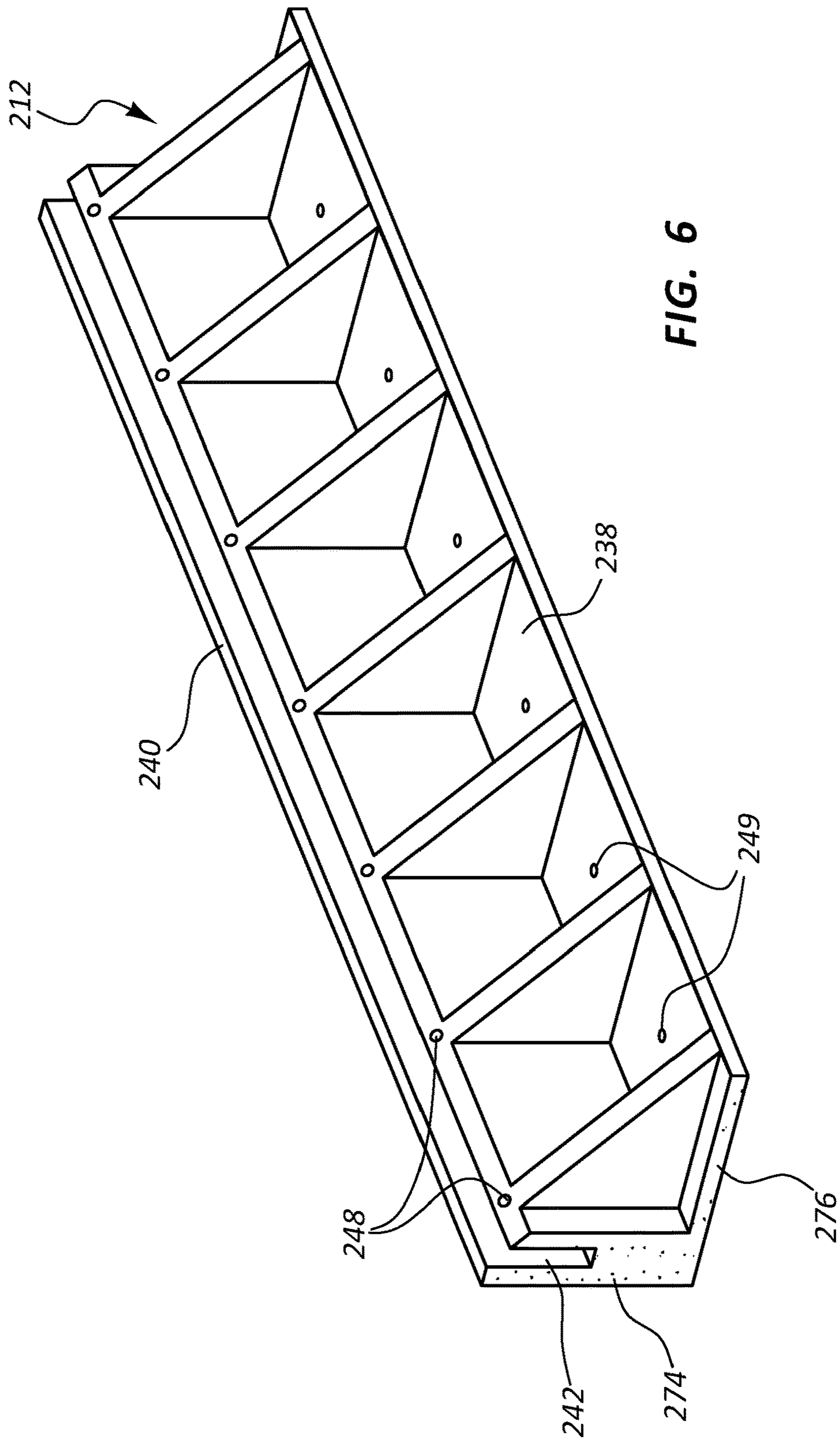


FIG. 6

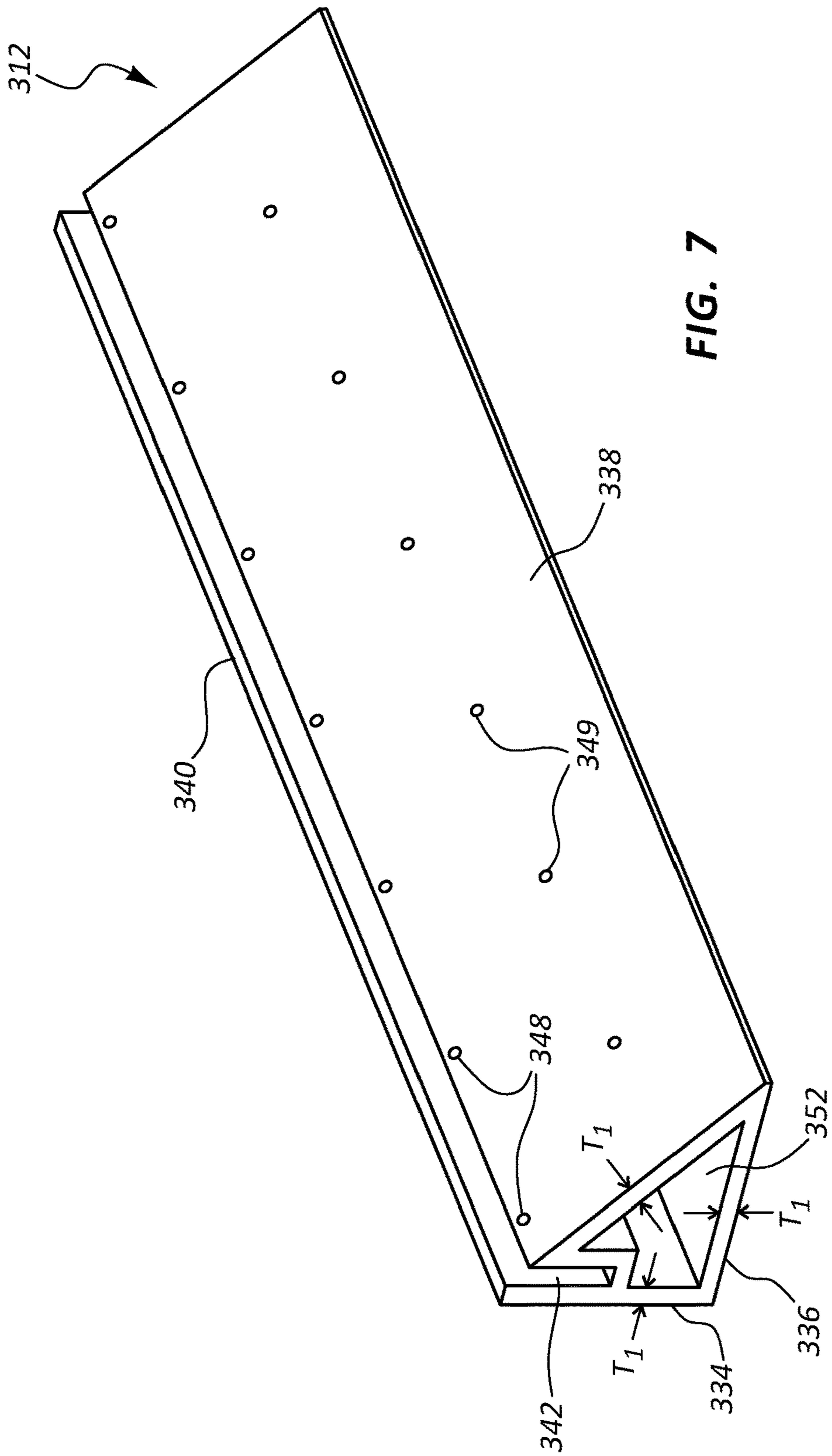


FIG. 7

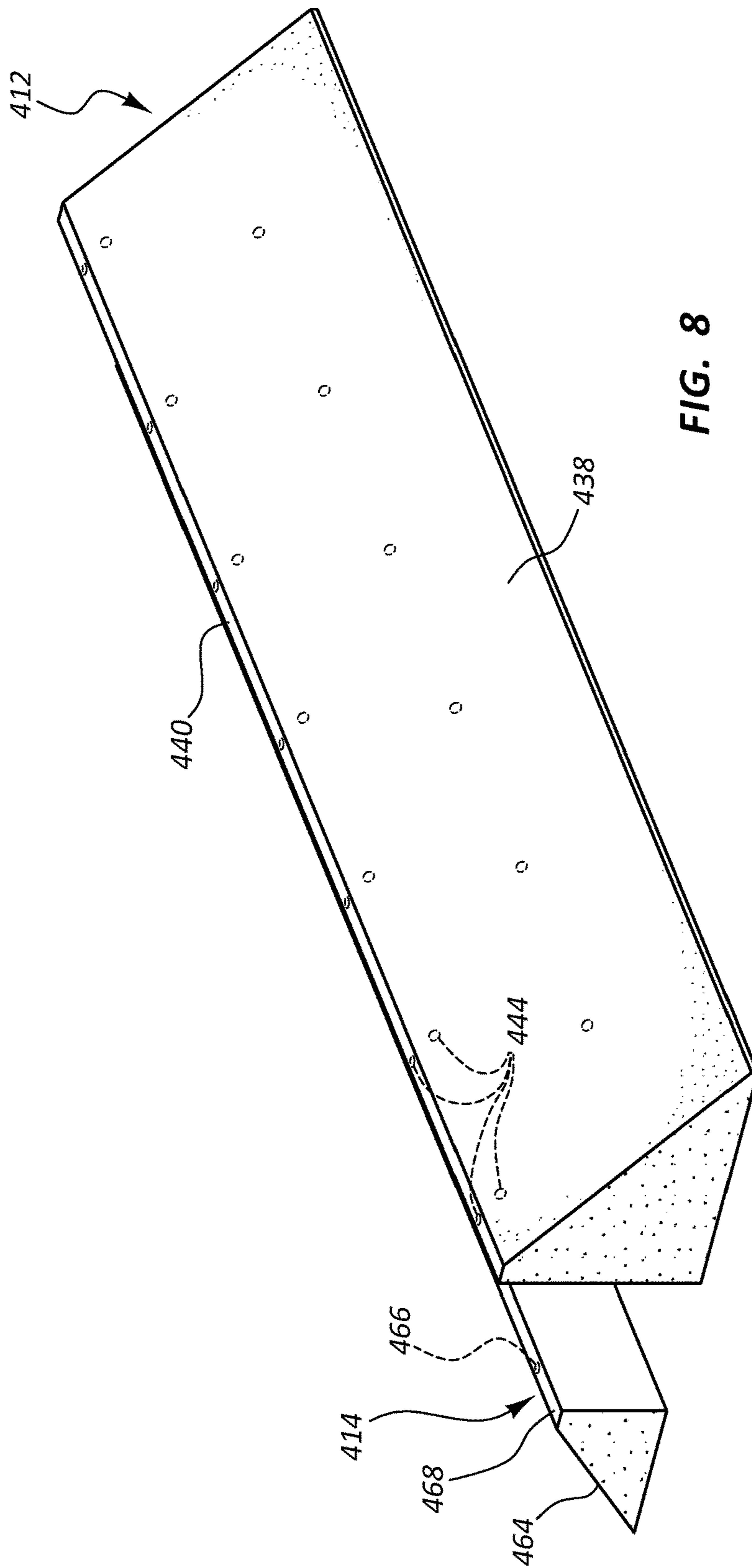


FIG. 8

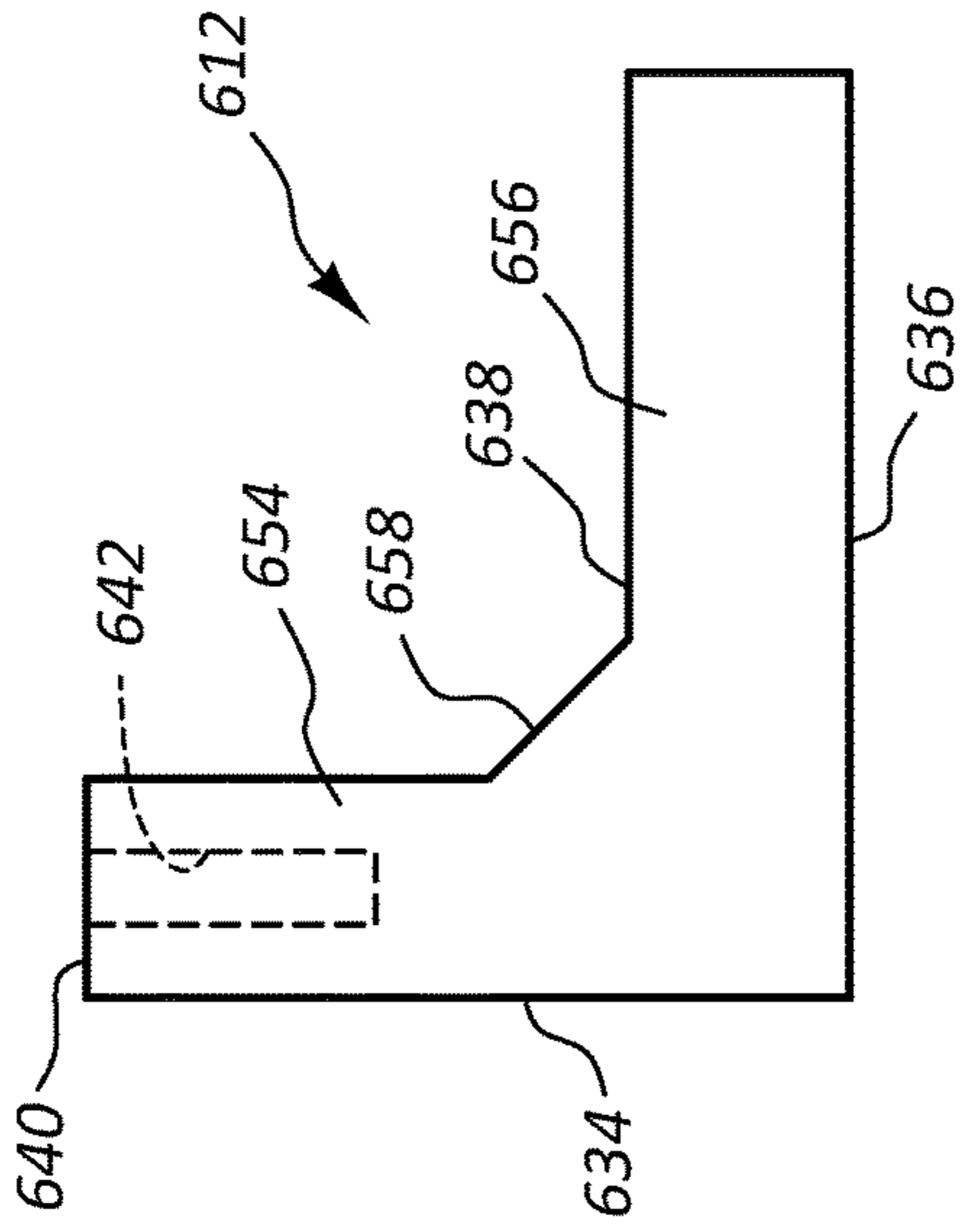


FIG. 9C

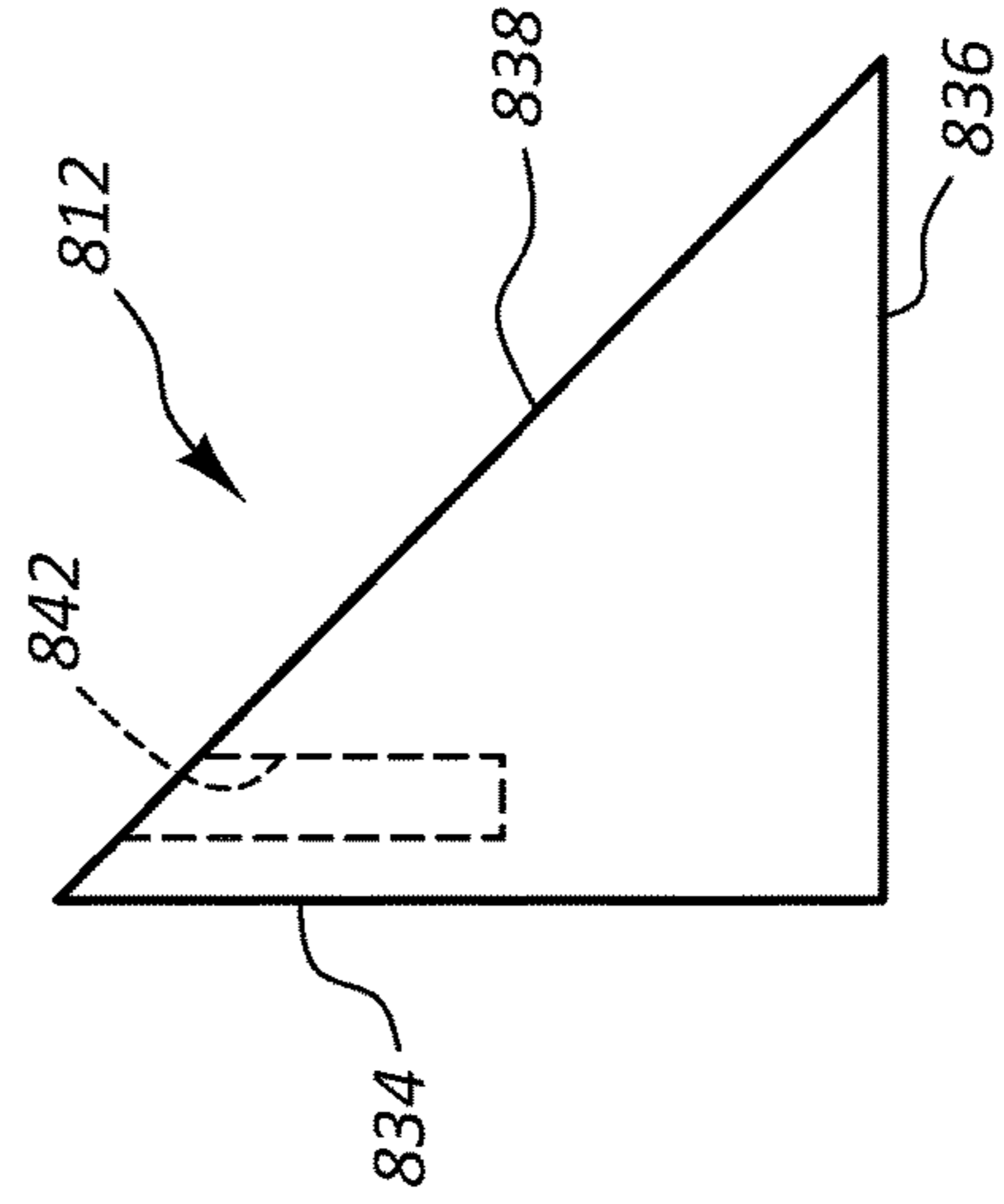


FIG. 9D

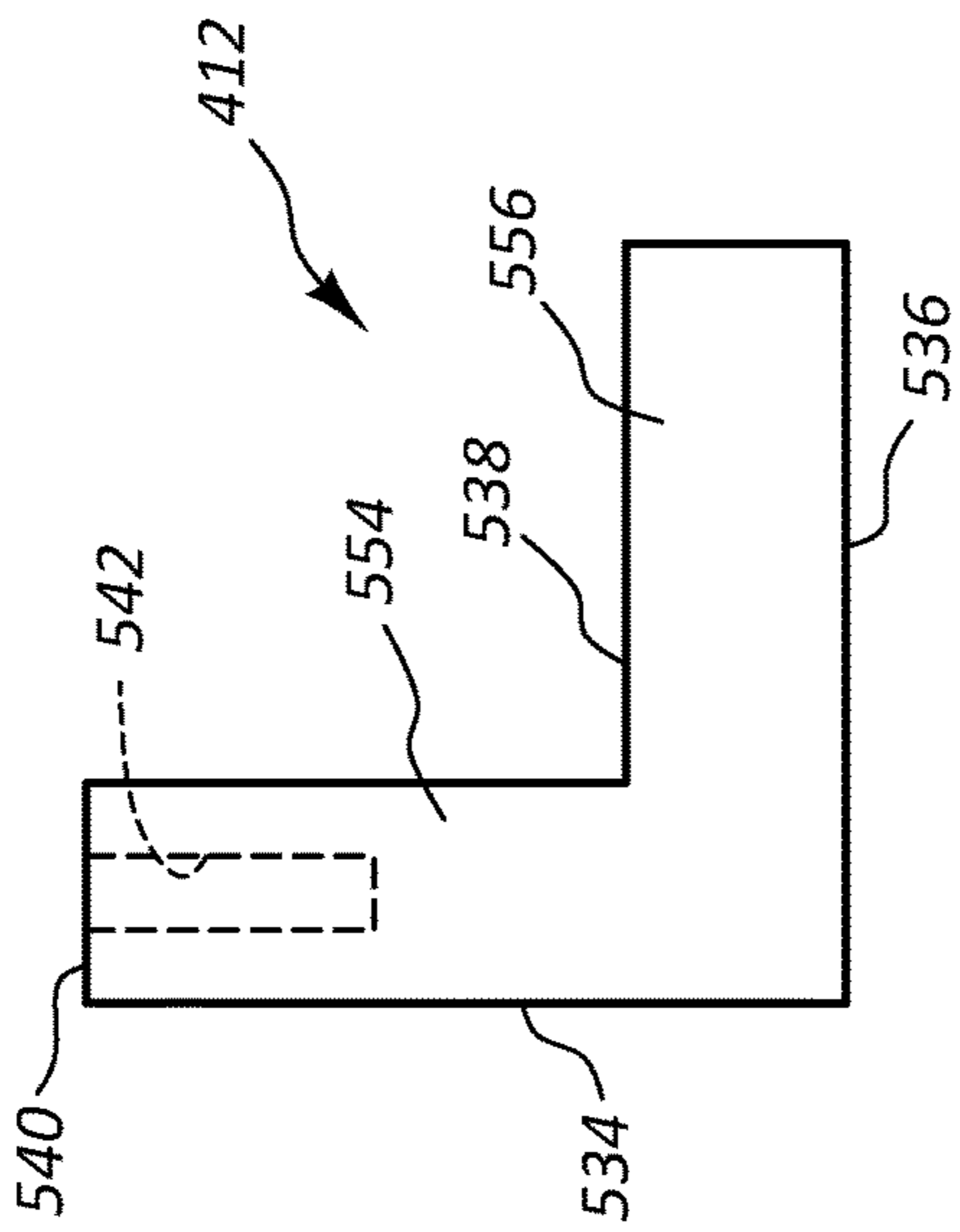


FIG. 9A

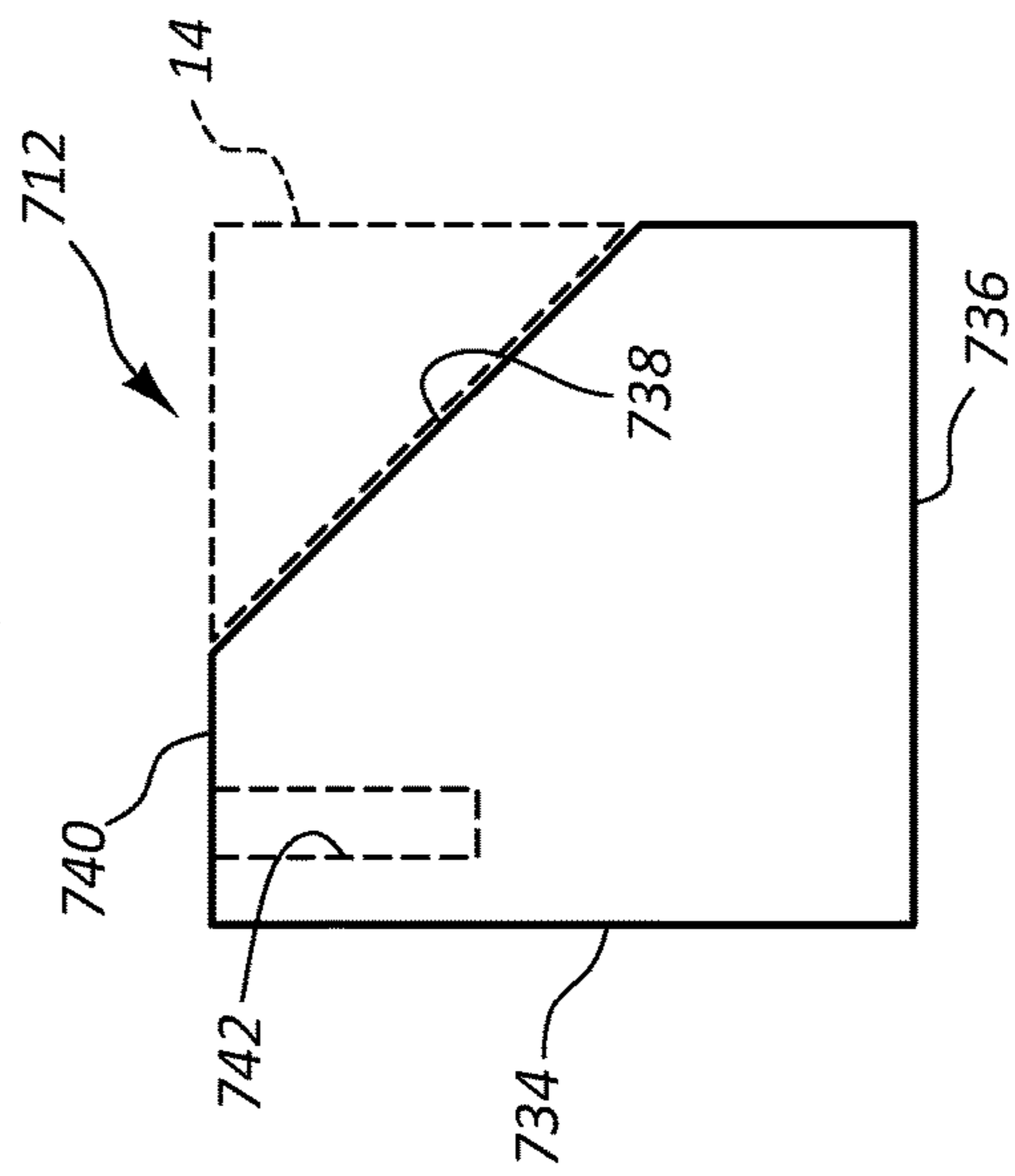


FIG. 9B

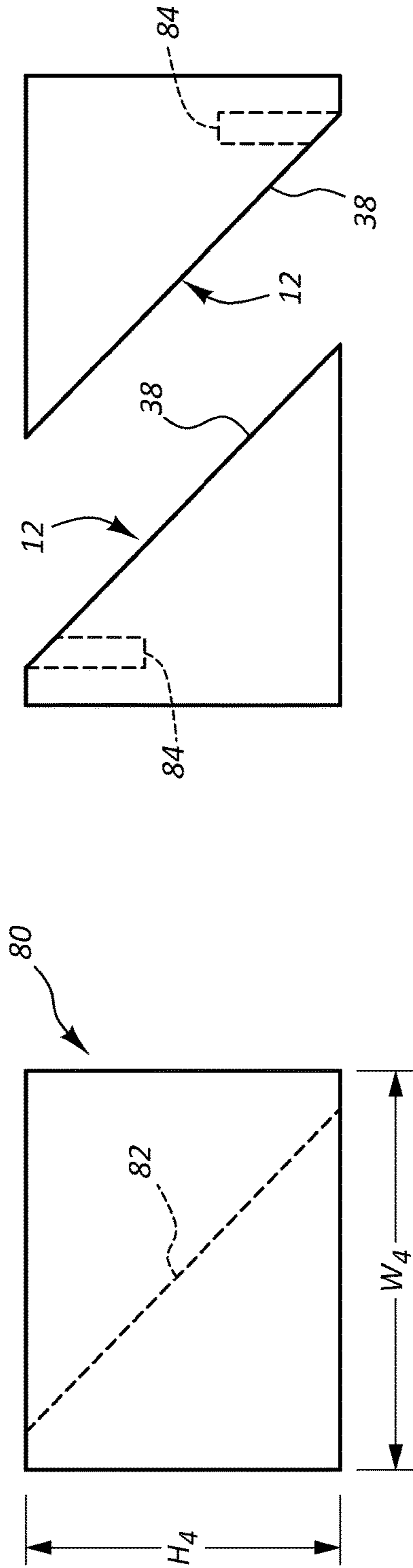


FIG. 10A

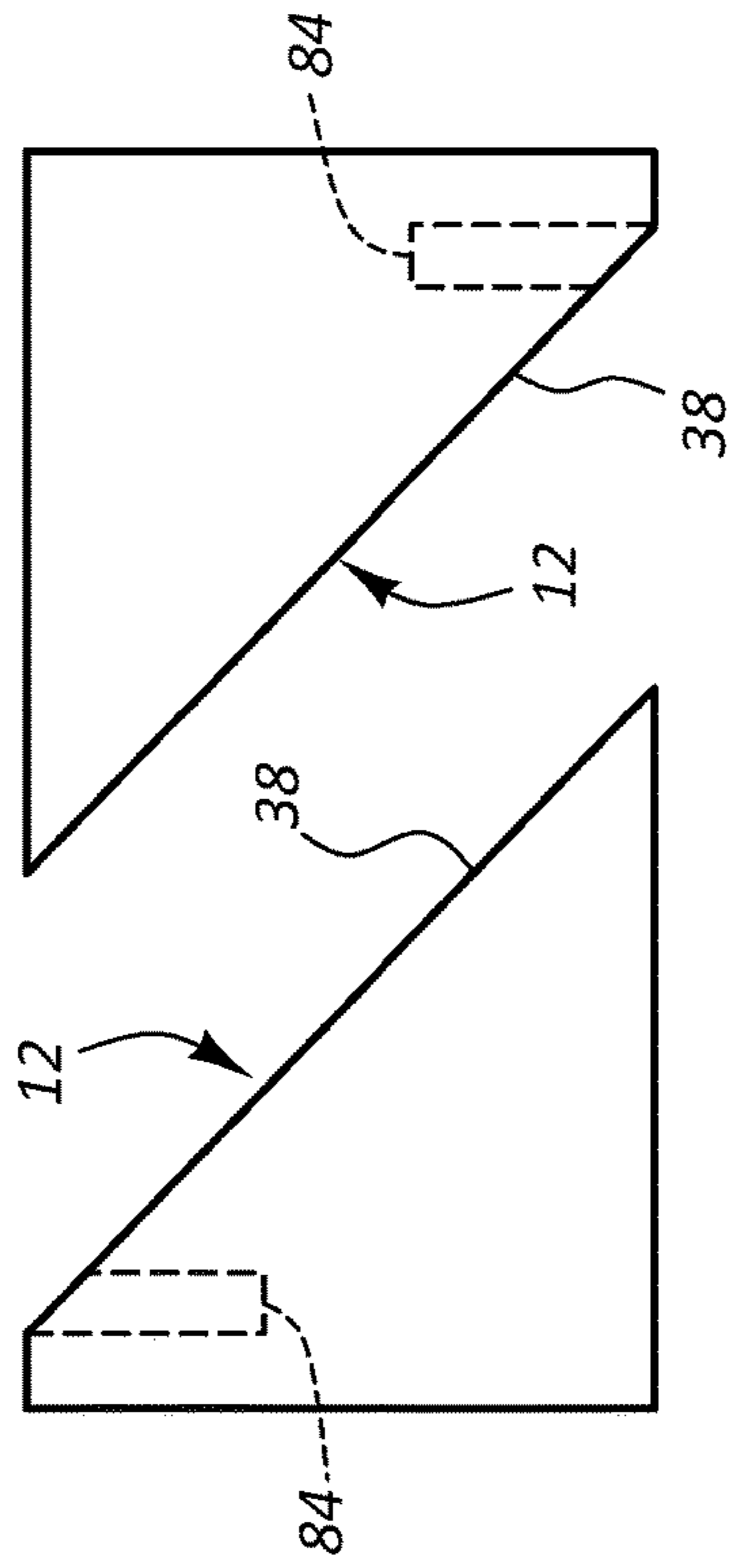


FIG. 10B

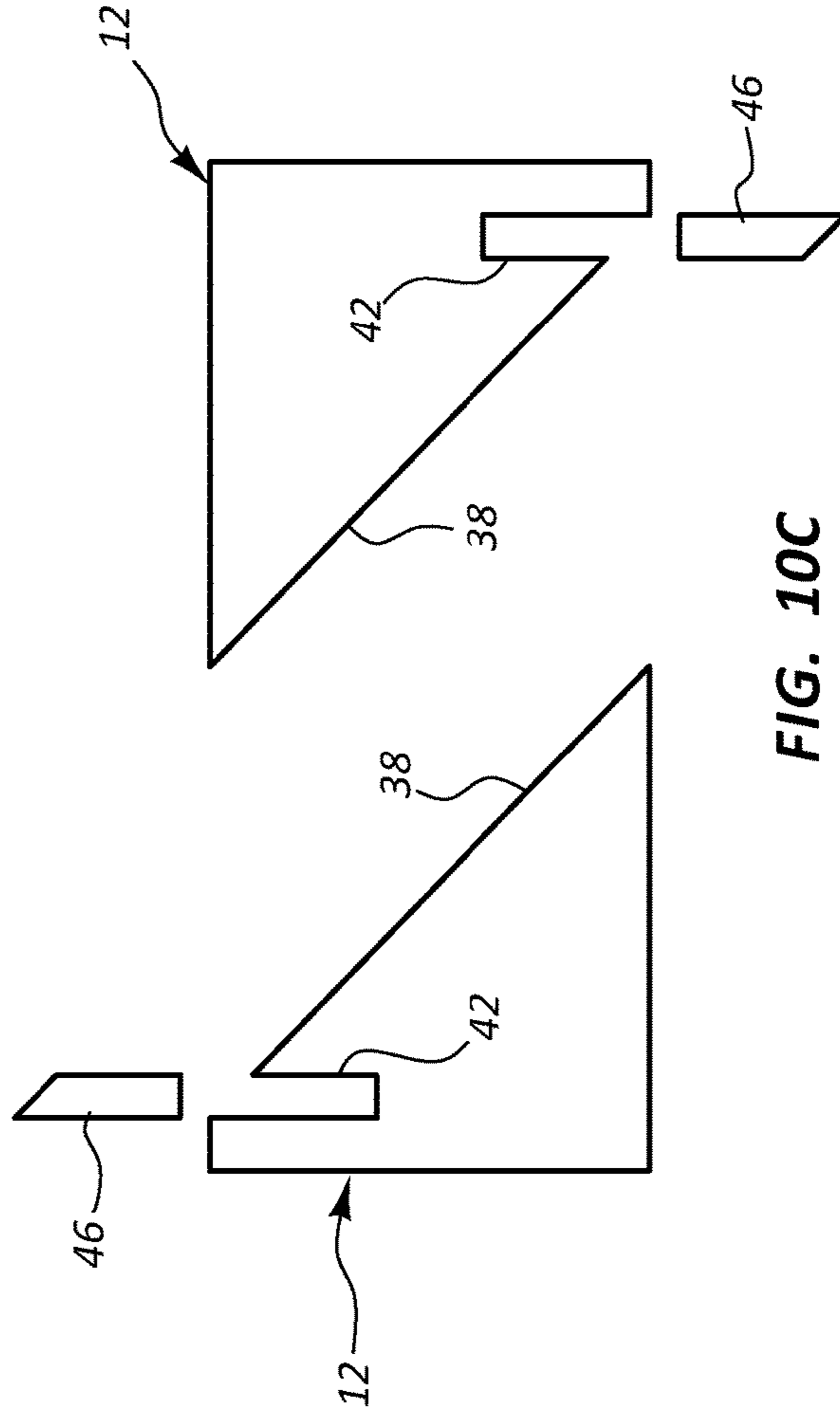


FIG. 10C

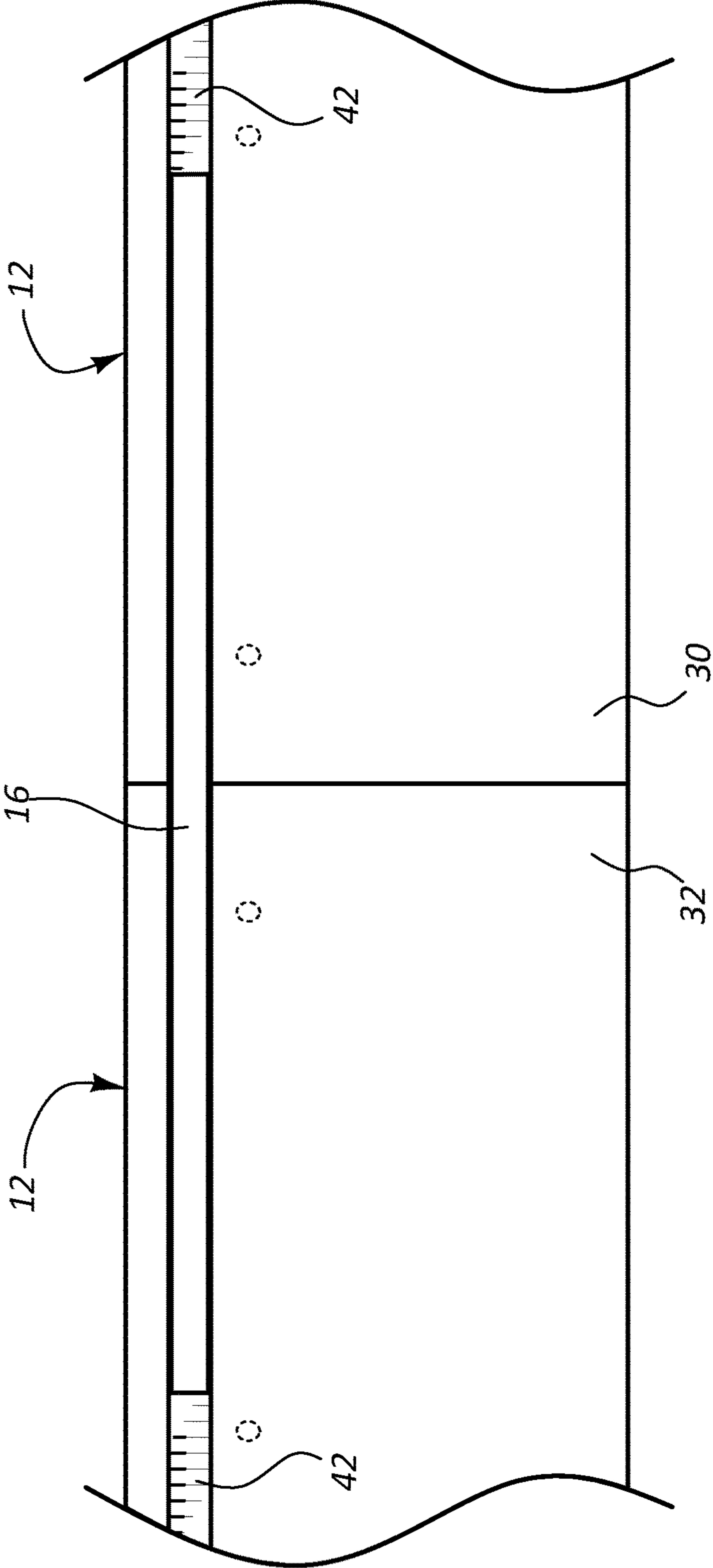


FIG. 11

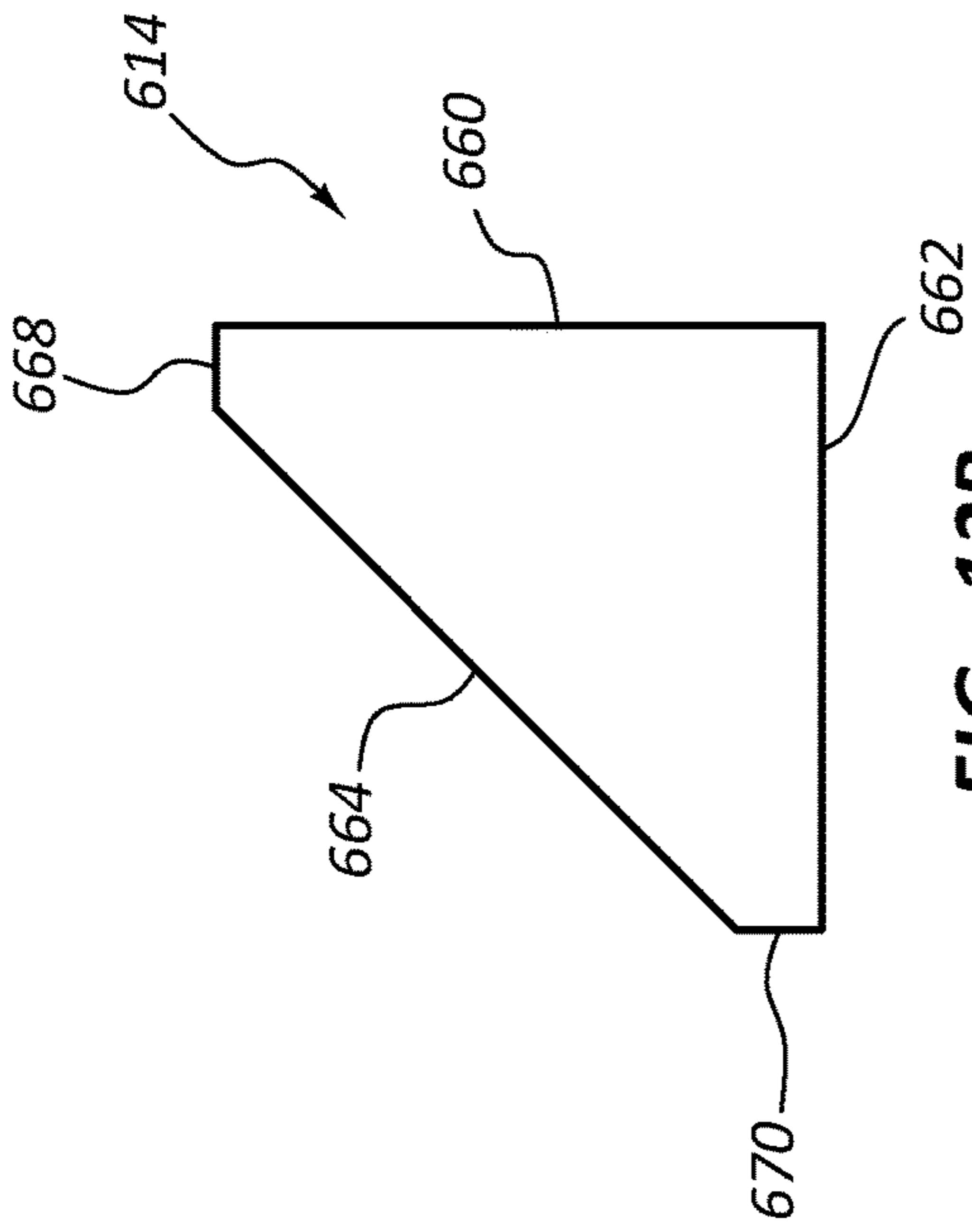


FIG. 12A

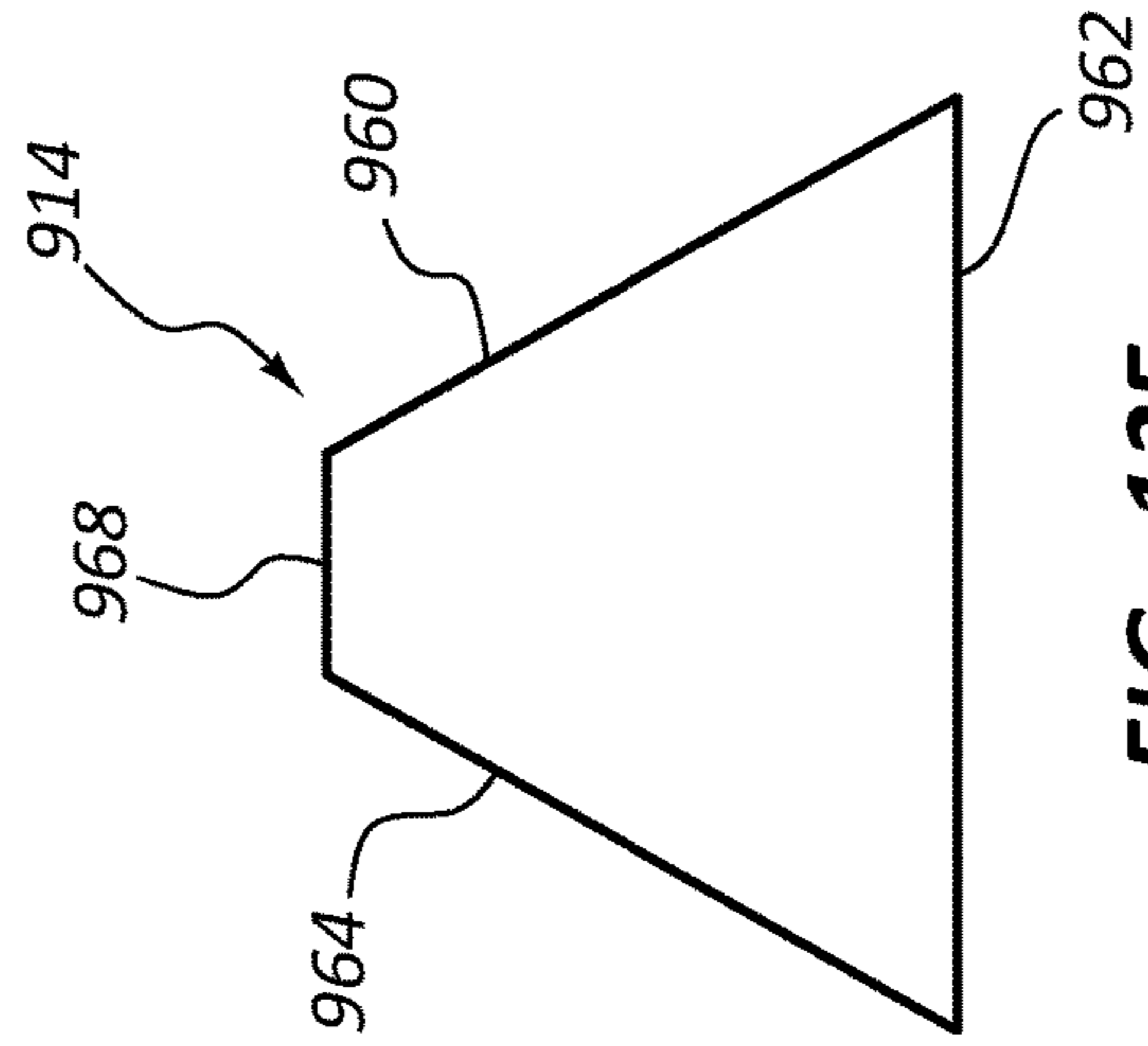


FIG. 12B

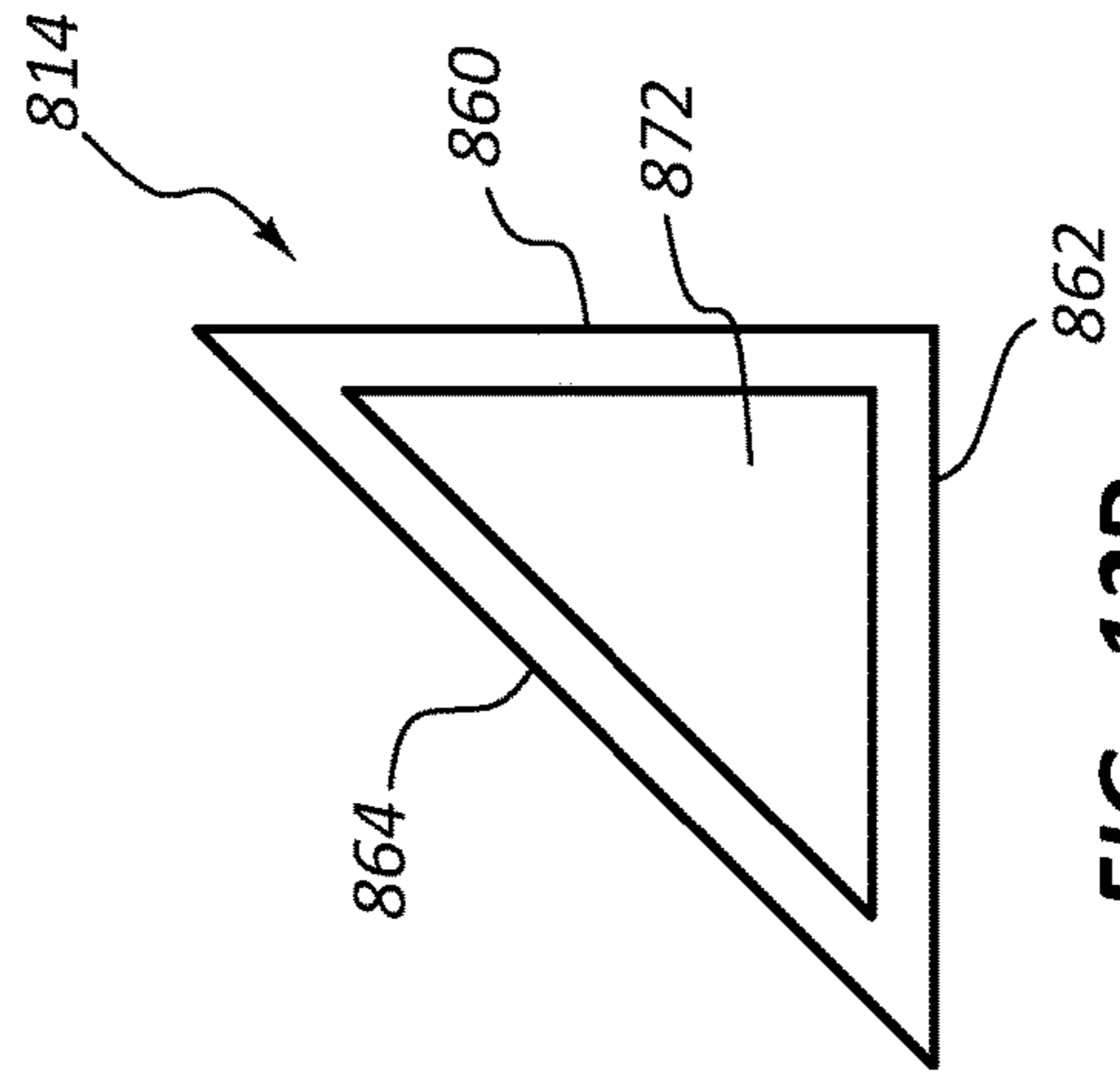


FIG. 12C

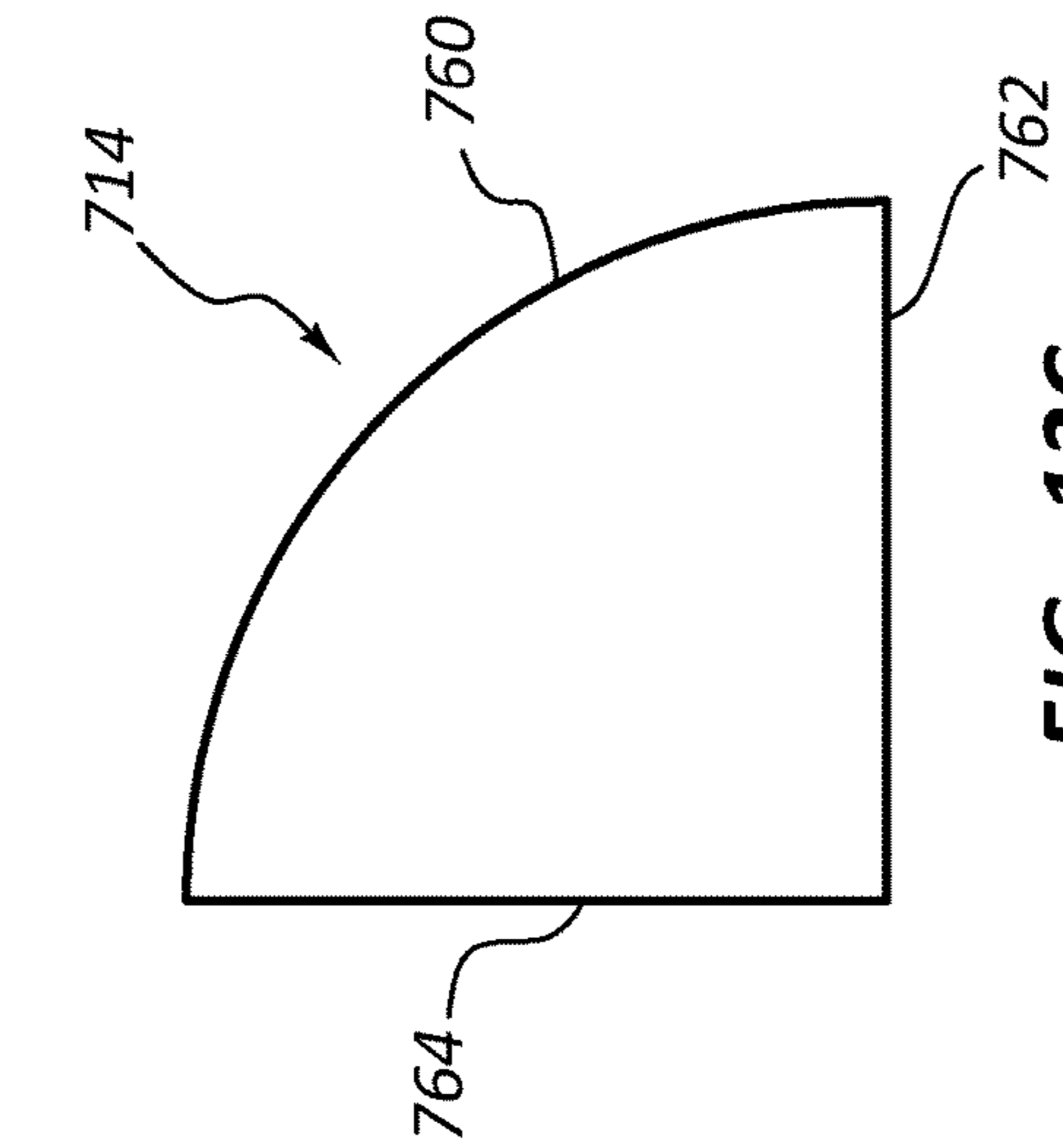


FIG. 12D

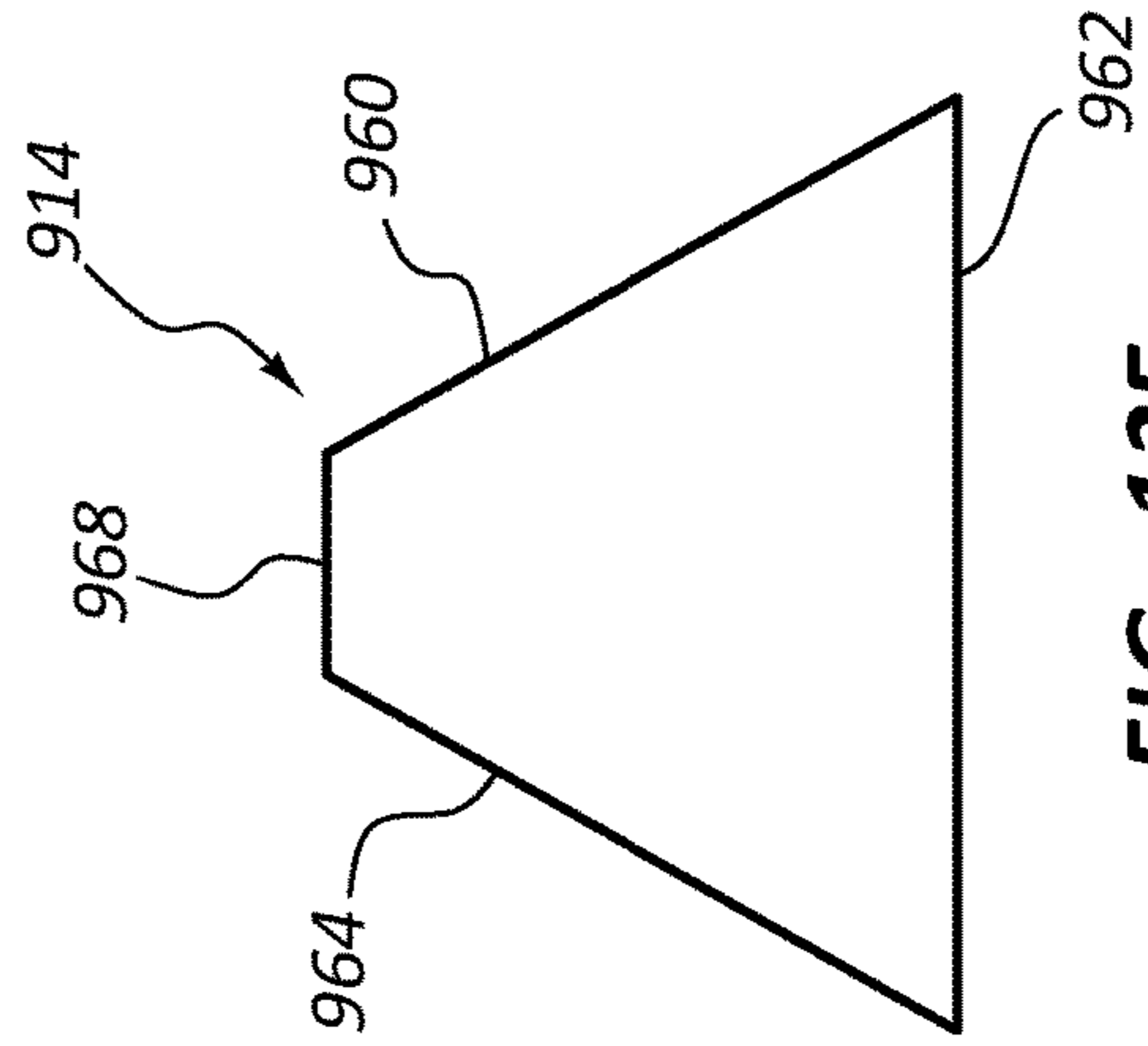
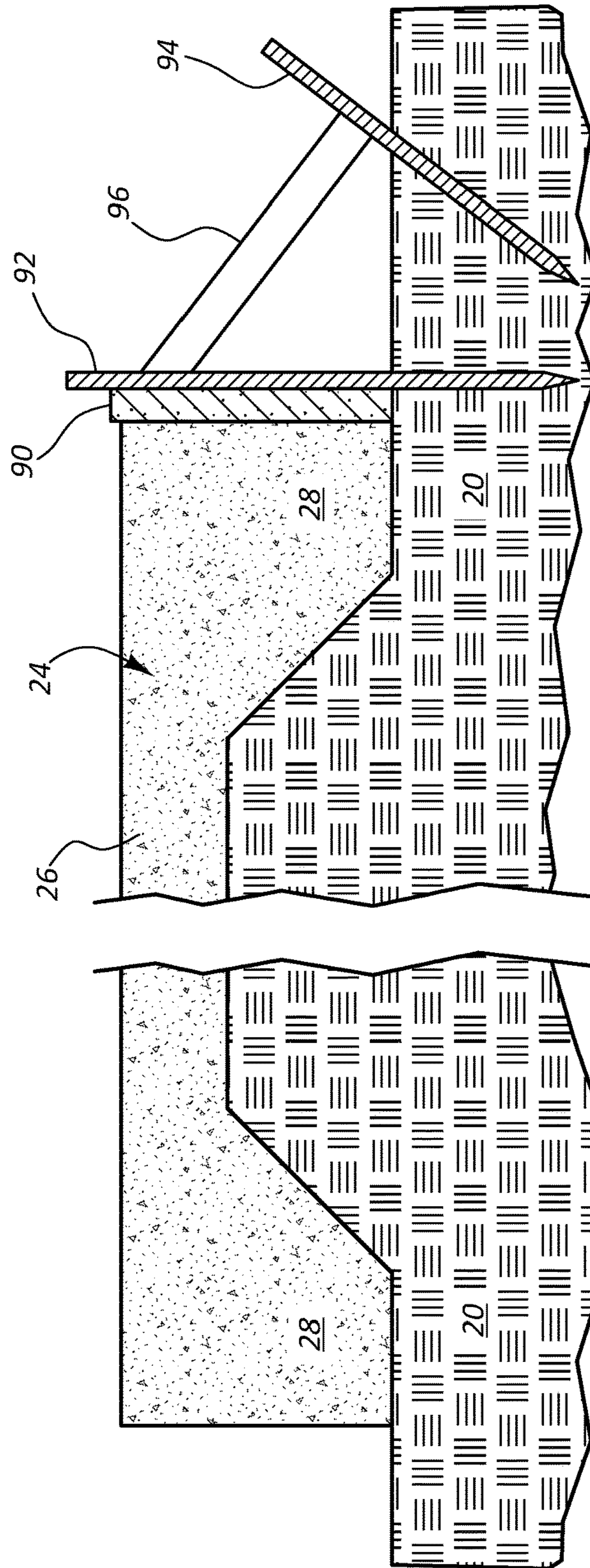
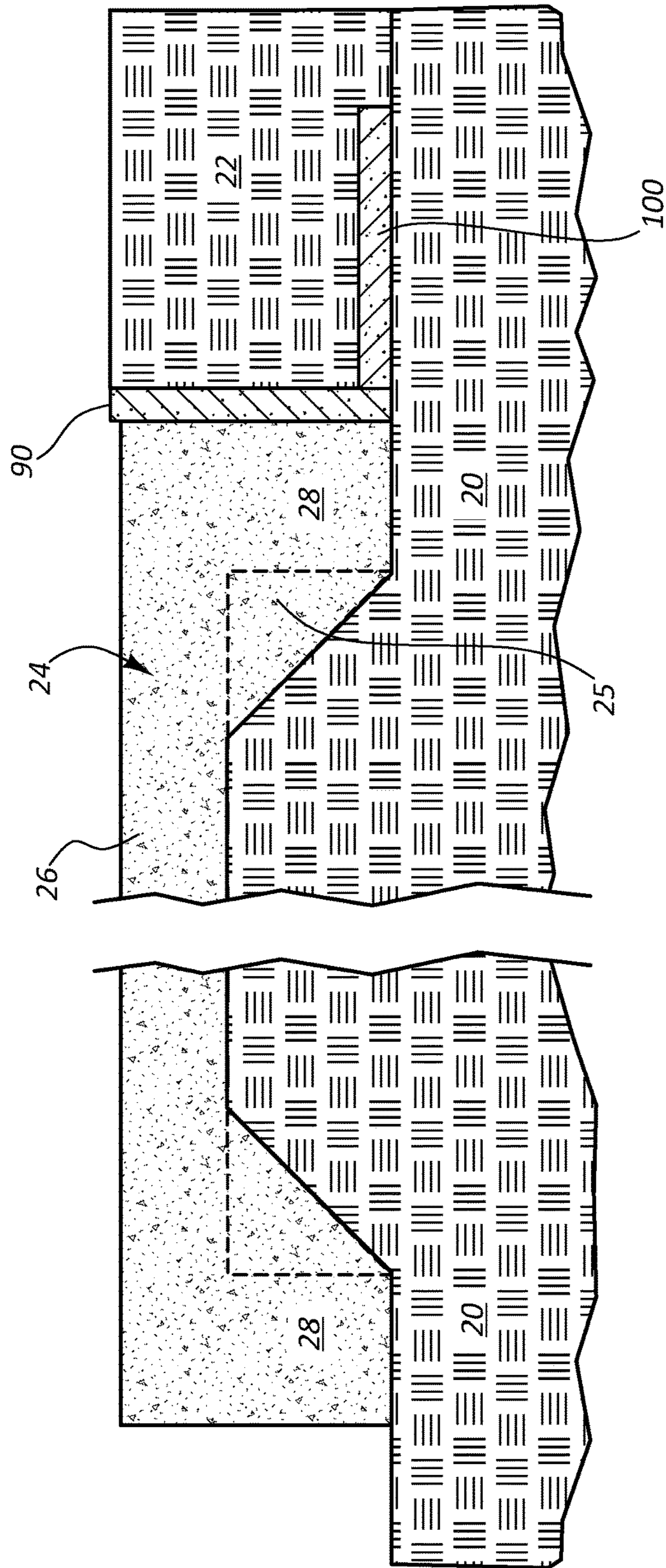


FIG. 12E



**FIG. 13A**  
*(Prior Art)*





**FIG. 13B**  
*(Prior Art)*

**CEMENT FORM APPARATUS AND METHOD**

## TECHNICAL FIELD

The present disclosure generally relates to cement forms used to create cement structures such as building foundations.

## BACKGROUND

Traditionally, cement forms are held in place with an arrangement of metal stakes, kickers and other supporting structure. The traditional methods for forming a monolithic building foundation are particularly time intensive to set up and take down after the cement monolithic foundation is poured. After the form is removed, dirt is backfilled around the foundation to provide support and soil grading. In certain cold climates, foam insulation sheets are positioned against the sidewall of the foundation and extending laterally from the sidewall after the form is removed and before dirt is backfilled around the foundation. The foam insulation provide a desired R value that helps hold in heat from the building within the foundation, thereby providing protection again extreme expansion and contraction of the foundation resulting from outside temperature changes.

## SUMMARY

According to one aspect of the present disclosure, a cement form includes a first surface arranged vertically and configured to support a volume of cement, a second surface arranged horizontally and configured to contact a ground support surface, and at least one of a foam material and a polymer material.

The cement form may have a wedge-shaped cross-section. The cement form may have a triangular cross-section shape. The cement form may further include a weight bearing surface facing at least in part in a vertical direction. The cement form may include a connector groove extending along at least a portion of a length of the cement form. The connector groove may be configured to receive a connecting member that extends between adjacent positioned cement forms. The cement form may include at least one aperture sized to receive a support stake extending through the cement form.

Another aspect of the present disclosure related to a cement form that includes an elongate member having a wedge-shaped cross-sectional shape and is formed from a foam material. The elongate member may include a connector groove sized to receive a connecting member that spans between adjacent positioned cement forms. The elongate member may be configured to receive a support stake through the foam material to connect the cement form to a ground surface without pre-forming a pass-through bore in the elongate member sized to receive the support stake. The cement form may be configured to be at least partially covered with backfill dirt prior to forming a cement structure using the cement form. The elongate member may include a first surface arranged vertically and configured to support a volume of cement, and a second surface arranged horizontally and configured to contact a ground support surface. The foam material may include at least one of expanded polyethylene and high density foam.

A further aspect of the present disclosure relates to a cement form assembly that includes at least two cement forms each comprising at least one of a foam material and a polymer material, and each having at least one connector

groove formed therein. The cement form assembly also includes at least one connecting member positioned in the connector grooves and spanning between the at least two cement forms to interconnect the at least two cement forms, and a plurality of support stakes extending through the at least two cement forms and into a ground support.

The at least two cement forms may each have a wedge-shaped cross-section. The cement form assembly may also include an inner insert configured to be spaced inward from the at least two cement forms and arranged to be positioned under a cement structure formed using the cement form. The at least two cement forms each include at least one pass-through bore sized to receive one of the plurality of support stakes.

Another aspect of the present disclosure relates to a method of forming a monolithic foundation. The method includes providing a plurality of cement forms each comprising a foam material, staking the plurality of cement forms to a ground surface, interconnecting at least some of the plurality of cement forms, covering at least a portion of the plurality of cement forms with backfill dirt, thereafter, pouring cement into contact with the plurality of cement forms to form a monolithic foundation, and leaving the plurality of cement forms covered and in contact with the monolithic foundation after the cement cures to provide insulation for the monolithic foundation.

Staking the plurality of cement forms may include driving a stake through the foam material, and driving the stake through the foam material concurrently forms a pass-through aperture through the foam material. Interconnecting the plurality of cement forms may include removably inserting a connecting member into connector grooves of adjacent positioned cement forms. The method may include removing the connecting member from the connector grooves after the cement is cured. The method may include inserting a foam strip into the connector grooves after removing the connecting member.

The above summary is not intended to describe each embodiment or every implementation of embodiments of the present disclosure. The Figures and the detailed description that follow more particularly exemplify one or more preferred embodiments.

## BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings and figures illustrate a number of exemplary embodiments and are part of the specification. Together with the present description, these drawings demonstrate and explain various principles of this disclosure. A further understanding of the nature and advantages of the present invention may be realized by reference to the following drawings. In the appended figures, similar components or features may have the same reference label.

FIG. 1 is a perspective view of a cement form assembly in accordance with the present disclosure.

FIG. 1A is a top view of the cement form assembly shown in FIG. 1.

FIG. 2 is a perspective view of the cement form assembly shown in FIG. 1 with connecting members.

FIG. 3 is a perspective view of the cement form assembly of FIG. 2 used to form a monolithic foundation.

FIG. 4 is a perspective view of the cement form assembly shown in FIG. 3 with connecting members removed and a structure supported on the foundation.

FIG. 5 is a perspective view of another cement form in accordance with the present disclosure.

FIG. 6 is a perspective view of another cement form in accordance with the present disclosure.

FIG. 7 is a perspective view of another cement form in accordance with the present disclosure.

FIG. 8 is a perspective view of a cement form and inner insert in accordance with the present disclosure.

FIGS. 9A-9D are end views of further cement form embodiments in accordance with present disclosure.

FIGS. 10A-10C show steps of forming a cement form in accordance with the present disclosure.

FIG. 11 is a top view of a pair of cement forms interconnected in accordance with the present disclosure.

FIGS. 12A-12E are end views of inner insert embodiments in accordance with the present disclosure.

FIGS. 13A and 13B show a prior art cement form assembly.

While the embodiments described herein are susceptible to various modifications and alternative forms, specific embodiments have been shown by way of example in the drawings and will be described in detail herein. However, the exemplary embodiments described herein are not intended to be limited to the particular forms disclosed. Rather, the instant disclosure covers all modifications, equivalents, and alternatives falling within the scope of the appended claims.

#### DETAILED DESCRIPTION

The present disclosure generally relates to cement forms used to form cement structures such as cement foundations. The apparatuses and methods of the present disclosure are particularly useful for forming monolithic foundations in which the footings and floor are poured as a single, monolithic structure. The apparatuses and methods of the present disclosure are also particularly useful for forming The disclosed cement forms, cement form assemblies, methods of making cement forms/cement form components, and methods of forming cement structures using the disclosed cement forms may be used in place of traditional wood/metal cement forms that are labor intensive to set up and must be removed after pouring the cement, and foam insulation sheets that are required in cold climates to be buried adjacent to the cement structure (e.g., cement foundation) to limit frost damage to the cement structure.

One aspect of the present disclosure relates to a cement form that is comprised substantially of a foam material such as, for example, expanded polyethylene or high density foam (e.g., known as Blue Board). The foam cement form may be used to form a cement structure by containing the cement while being poured and cured. The cement form remains in contact with the cement structure to later provide an insulating function to insulate the cured cement. The foam cement form may be at least partially buried prior to pouring the cement. The backfill material used to at least partially bury the foam cement form may help hold the form in place while the cement is being poured and cured.

Another aspect of the present disclosure relates to cement forms formed from a polymer material such as, for example, polyethylene or other polymer. Various molding processes may be used to form the polymer cement form including, for example, blow molding, drape forming, injection molding, and the like. A polymer cement form may include additional intricate features such as support ribs, pass-through bores, grooves, internal cavities, and the like which may be more difficult to form in a foam cement form. Further, a polymer cement form in accordance with the present disclosure may be reusable for forming a plurality of cement structures,

wherein the polymer cement form is removed from the cement structure after curing of the cement.

Another aspect of the present disclosure relates to methods of forming a cement structure such as a monolithic foundation. Such methods may include use of a foam cement form or a polymer cement form in accordance with the present disclosure. Such methods may also include the use of an internal insert that is positioned under or internal the cement structure. The internal insert may comprise a foam material, a polymer material, or the like. Typically, the internal insert is provided to help minimize the amount of cement that is needed to create the cement structure. The cost and labor associated with using an internal insert is usually less than the extra amount of cement that may otherwise be required to create the cement structure. In at least some examples, the internal insert may provide an additional insulating property that increases the R value associated with protecting the cement structure from fluctuations in temperature.

A further aspect of the present disclosure relates to methods of forming foam cement forms and polymer cement forms. Such methods may be implemented to provide cost-effective, efficient production of cement forms. The cement forms may be structured as part of such manufacturing methods to facilitate assembly, storage, and shipping that is more efficient and cost-effective than those available for existing cement forms.

Referring to FIGS. 1-5, an example cement form assembly 10 is shown and described. The cement form assembly 10 includes a cement form 12 and an inner insert 14 (see FIG. 1). The cement form 12 and inner insert 14 are particularly useful for forming a building foundation, such as a monolithic foundation. Cement form 12 is used to support an exterior wall of the foundation. The inner insert 14 is positioned spaced inward from the cement form 12 and at a location that defines an inner and bottom surface of the foundation. Each of cement form 12 and inner insert 14 have a wedge shaped cross-sectional shape in the embodiment shown in FIG. 105. A vertical surface of the wedge shape defines a supporting surface that contains cement that is poured to form the foundation. A bottom, downward facing surface of each of the wedge shaped structures rests against a ground support and has sufficient width to maintain the cement form 12 and inner insert 14 in an upright position without the use of stakes, kickers, or other structures typically used in known cement form assemblies. The cement form 12 and inner insert 14 may be held in a specific position along the ground support using stakes that are driven through the cement form 12 and inner insert 14 and into the ground support, or driven into the ground support at a position directly adjacent to the cement form 12 and inner insert 14. The support stakes are typically not needed to hold the cement form 12 and inner insert 14 in an upright position.

Referring to FIGS. 13A and 13B, a traditional cement form assembly is shown. The traditional assembly includes a cement form 90 that is held in place along a ground support 20 with a plurality of form stakes 92. A plurality of kickers 96 extend diagonally from the cement form 90 to hold the cement form 90 in a vertical, upright position. The kickers 96 are held in place with a plurality of kicker stakes 94. The process of setting up the form assembly shown in FIG. 13A is extremely labor intensive because not only does the cement form 90 need to be held in an upright position, but also needs to be held in a fixed lateral and axial position along the ground support 20.

The ground support **20** is pre-shaped to match the desired dimensions for a slab **26** and footings **28** of a foundation **24**. The increased depth required for the footings **28** requires a tapering of the ground support **20** from the area of the slab **26** to the area of the footings **28**. Because the ground support **20** comprises dirt, gravel, or other fill material that is generally loose, it is difficult to form the transition between the slab support area and foundation support area of the ground support **20** in a square shape represented by feature **25** in FIG. 13B. The feature **25** shown in FIG. 13B represents the additional cement that is required to fill the transition space between the slab support portion and foundation support portions of the ground support **20**. This additional cement can be significant, particularly when forming large foundations. This additional cement is unnecessary from a structural perspective for the foundation, but is a required additional cost when using traditional methods to form monolithic foundations.

Referring to FIG. 13B, after the foundation **24** is poured and cured, the cement form **90**, stakes **92**, **94** and kicker **96** are removed, and a pair of foam sheets **98**, **100** are positioned resting against the exterior, lateral surface of the foundation **24** and against the ground support **20** adjacent to foundation **24**. The foam sheets **98**, **100** provide insulation for foundation **24** and provide a certain R value. In at least some cases, the foam sheets **98**, **100** help retain heat within the foundation **24** so that the heat does not immediately dissipate into backfill **22** that is later used to cover the foam sheets **98**, **100** and grade the ground surface adjacent to foundation **24**. The backfill **22** may be in the form of dirt, gravel, or other fill material. The backfill **22** holds the foam sheets **98**, **100** in their respective positions in contact with the lateral outside surface of foundation **24** and along the ground support **20** extending laterally outward from foundation **24**.

The traditional structures and methods of forming monolithic foundations and other cement structures as represented in FIGS. 13A and 13B have many disadvantages, inefficiencies, and unnecessary costs. The apparatuses and methods disclosed herein, particularly with reference to FIGS. 1-12E address many of the drawbacks associated with the traditional apparatuses and methods described with reference to FIGS. 13A and 13B.

Referring again to FIG. 1, the cement form **12** includes first and second ends **30**, **32**, a first surface **34**, a second surface **36**, and a weight bearing surface **38**. Cement form **12** may also include a top surface **40** and a connector groove **42**. Cement form **12** may optionally include a plurality of stake openings or apertures **44** positioned along a length  $L_1$ . The stake openings **44** may be provided as pass-through bores that extend from the weight bearing surface **38** or top surface **40**, through the body of cement form **12** and out through second surface **36**.

The first surface **34** may be arranged generally vertical or aligned parallel with a vertical plane. First surface **34** may support a volume of concrete that is poured into a space between cement form **12** and inner insert **14**. First surface **34** may have any desired shape, size and orientation to provide the desired shape, size and orientation of a resulting surface of a cement structure supported by cement form **12**. First surface **34** is shown having a height  $H_1$ . The height  $H_1$  may be in the range of, for example, about 4 inches to about 60 inches, and more preferably in the range of about 12 inches to about 24 inches, which is common for standard monolithic foundations. First surface **34** may include a decorative pattern that results in a decorative pattern formed on the side surface of the cement structure (e.g., foundation). Such a

decorative pattern may be visible in the event that cement form **12** is removed and the side surface of the cement structure is exposed for viewing.

Second surface **36** typically is oriented generally horizontally or aligned parallel with a horizontal plane. Second surface **36** rests upon a ground support **20**. Typically, the ground support **20** is generally planer or arranged in a horizontal plane at least in the area where the cement form **12** is positioned. Second surface **36** may have a width  $W_1$  that is in the range of, for example, about 6 inches to about 48 inches and more particularly in the range of about 12 inches to about 24 inches. In at least some embodiments, the width  $W_1$  is substantially equal to the height  $H_1$  of first surface **34**. The width  $W_1$  is typically equal to or greater than the height  $H_1$  to provide balance and support for the cement structure being formed. However, the ratio between weight  $W_1$  and height  $H_1$  may vary based upon a variety of factors including, for example, materials used for cement form **12**, the amount of cement supported by cement form **12** and other structural features of cement form **12** such as, for example, the size and shape of connector groove **42**, an angle  $\theta$  that defines an orientation of weight bearing surface **38**, the amount of backfill that is possible to cover weight bearing surface **38** prior to pouring the cement structure, and the like.

The weight bearing surface **38** is substantially planer and extends from an outermost edge of second surface **36** toward the first surface **34**. A plurality of stake openings **44** may be formed in the weight bearing surface **38**. In at least some examples, cement form **12** comprises a material that permits driving a stake through the cement form **12** without preforming a stake opening **44**. Driving a stake through the cement form **12** may concurrently form a stake opening. Such materials are commonly foam materials as described above, but may include other materials that can be punctured without cracking or otherwise failing structurally. The use of certain foam materials permits driving stakes through cement form **12** at any desired location along the weight bearing surface **38**, within connector groove **42**, or through top surface **40**. In some embodiments, stakes may be driven into ground support **20** at an outer edge of cement form **12** at the interface between second surface **36** and weight bearing surface **38** to prevent sliding of the cement form **12** in at least one direction along ground support **20**. Stakes may be temporarily driven into ground support **20** along an opposite edge of cement form **12** at the interface between first and second surfaces **34**, **36** prior to pouring the cement structure. Such temporarily position stakes may remain in place while taking other steps related to setting up the cement form assembly **10** such as, for example, inserting connecting members into connector groove **42**, driving stakes through stake openings **44** or along the outer edge of cement form **12**, and/or at least partially covering weight bearing surface **38** with a backfill dirt or gravel material.

The connector groove **42** may be positioned along the weight bearing surface **38**. Connector groove **42** may be accessible along a top side of cement form **12**. Connector groove **42** may be open facing in a generally vertical or upward direction. In at least some examples, connector groove **42** is formed in top surface **40** rather than in weight bearing surface **38**, or a combination of the two. Connector groove **42** is shown having a maximum height  $H_3$  and a width  $W_3$ . In at least some examples, connector groove **42** is dimensioned to receive a standard board size such as a 2"×4", 2"×6" or 2"×8" board. Such a board may be referred to as a connecting member **16** (see FIGS. 2-3). The boards or connecting member **16** may be positioned within con-

connector groove 42 and spanned between adjacent positioned cement forms 12 to provide an interconnection of adjacent position cement forms 12. Connector groove 42 is sized, shaped and oriented on cement form 12 to provide easy insertion and removal of such connecting members at various stages of setting up cement form assembly 10 and creating a cement structure, such as a monolithic foundation.

Typically, connectors are inserted into connector groove 42 prior to pouring cement to form a cement structure, and are later removed after the cement cures so that the connecting members may be reused for other cement form assemblies. The connector groove 42 may have any desired shape and size to accommodate connecting members of different shapes and sizes. In one example, the connecting members are in the form of a sheet of material, a clip structure, a bracket, or the like. Connector groove 42 may be customized in its shape, size and orientation to accommodate such connecting members. In some embodiments, connector groove 42 may extend along the entire length  $L_1$ . In other examples, the connector groove 42 extends along only a portion of the length  $L_1$  such as, for example, along portions directly adjacent to the first and second ends 30, 32.

The material of cement form 12 that is removed in order to form connector groove 42 may be saved and then reinserted in connector groove 42 after removal of the connecting members. This inserted material may help fill connector groove 42 to prevent backfill dirt or other objects from collecting in connector groove 42, which may otherwise reduce the R value of cement form 12 when cement form 12 is left in the ground and used to insulate the cement structure.

The cement form 12 may be used alone or in combination with inner insert 14. Inner insert 14 may eliminate the need for the extra cement 25 shown in FIG. 13B and discussed above. Inner insert 14 may be positioned along the ground support 20 in the area of the footing portion 28 of foundation 24 (see FIG. 13A). Inner insert 14 may be positioned adjacent to that portion of ground support 20 that supports the slab portion 26 of the foundation 24 (see FIG. 13A). Backfill material may be used to cover at least portions of the inner insert 14 on top of or adjacent to the portion of ground support 20 that supports the slab 26 thereby reducing the extra cement 25 that is otherwise needed.

Inner insert 14 includes a cement surface 60, a ground support surface 62, and a backfill support surface 64. Cement surface 60 has a height  $H_2$  and is arranged generally vertically and/or in parallel with a vertical plane. Ground support surface 62 has a width  $W_2$  and is arranged horizontally and/or parallel with a horizontal plane. Backfill support surface 64 extends from the ground support surface 62 to the cement surface 60 and may be arranged at an angle  $\alpha$  is directly dependent on the height  $H_2$  and width  $W_2$ . Inner insert 14 also has a length  $L_2$  (see FIG. 1A). Inner insert 14 is typically spaced apart from cement form 12 a distance  $X_1$ . The distance  $X_1$  is typically in a range of about six inches to about 36 inches, and more particularly in the range of about 12 inches to about 24 inches, which is typical for monolithic foundations.

Inner insert 14 may include a plurality of stake openings 66 positioned along the length  $L_2$  (see FIG. 1A). Inner insert 14 may comprise a foam material such as polyethylene foam or a high density foam. In some examples, inner insert 14 comprises a polymer material such as, for example, a polyethylene or other molded material. The materials used for inner insert 14 may be the same as those used to form cement form 12. Certain materials used for inner insert 14 may permit forming of the stake opening 66 as stakes are

driven through inner insert 14 and into ground support 20. In other examples, the stake opening 66 are pre-formed as, for example, pass-through bores that extend from backfill support surface 64 through ground support surface 62. The stake opening 66 may be formed at any location along the backfill support surface 64. In at least some examples, stakes are driven into ground support 20 adjacent to inner insert 14 but not extending through any portion of inner insert 14 to hold inner insert 14 in position during various steps leading up to pouring the cement structure. For example, stakes may be positioned along the cement surface 60 to hold inner insert 14 in position while backfill material is placed on the backfill support surface 64, and those stakes are removed prior to pouring the cement structure.

Referring to FIG. 2, the cement form assembly 10 is shown with connecting member 16 positioned in connector groove 42, stakes 18 driven through cement form 12 and into ground support 20, and backfill 22 positioned covering at least portions of the weight bearing surface 38 of cement form 12 and substantially all of the backfill support surface 64 of inner insert 14. The cement form assembly 10 is shown prepared for pouring cement to create a cement structure (e.g., monolithic foundation). Typically, the backfill dirt 22 is filled up to the connector groove 42 but typically not covering the connecting members 16. The backfill 22 can be filled to any desired height, but is typically always vertically lower than the connector groove 42 and/or the top surface 40. The stakes 18 may have ends that protrude through backfill 22 or may be positioned on cement form 12 in a way that they are completely buried by backfill 22. The stakes 18 may extend above the cement form 12, particularly above the weight bearing surface 38 or top surface 40 into which the stakes are driven. The stakes 18 may be later removed. In at least some examples, the stakes 18 are left positioned in cement form 12 even after the cement structures is cured. The stakes 18 may be in the form of, for example, wood or other insulating material that does not significantly reduce the R value of the cement form 12. Further, stakes 18 may comprise a relatively low cost material that makes it possible from a cost perspective to leave the stakes 18 positioned in cement form 12 permanently. In some examples, stakes 18 may be driven into ground support 20 a distance that buries then within the cement form 12 or at least flush with the weight bearing surface 38 and/or top surface 40 so that they are no longer exposed outside of backfill 22.

The backfill dirt 22 is typically grated to the top edge of inner insert 14 as shown in FIG. 2. In at least some examples, the top edge of inner insert 14 includes a flat surface, round surface, or the like to help reduce or otherwise minimize stress concentrations at an internal corner feature formed in the cement structure. Some additional inner insert embodiments are shown and described below with reference to FIGS. 12A-12E.

Referring to FIG. 3, a cement structure in the form of a monolithic foundation 24 is shown poured into the space between cement form 12 and inner insert 14 and covering inner insert 14. Foundation 24 includes a slab portion 26 and a footing portion 28. Foundation 24 may also include a plurality of rebar members 29 positioned internally. The cement form 12 is held in place laterally by stakes 18 and backfill 22. Cement forms 12 are also held in alignment relative to each other (e.g., relative to an adjacent cement form 12 that is positioned end to end therewith) with connecting members 16. Inner insert 14 may be held in place laterally and vertically using a plurality of stakes (not shown) and backfill 22. In at least some examples, the inner inserts 14 may also be interconnected with adjacent position

inner inserts using connecting members such as connecting members 16. The connecting members may be positioned within connector grooves or other features formed in inner inserts 14 to promote interconnection of the adjacent position inner inserts 14.

In at least some examples, the cement structure (e.g., foundation 24) may be poured without first covering at least a portion of cement form 12 with backfill 22. For example, the connecting member 16 and stakes 18 may provide sufficient support and connection between cement form 12 and ground support 20 that no backfill 22 is needed. However, in at least some examples, backfill 22 is used to cover at least portions of cement form 12 to provide additional support for cement form 12 during pouring of the cement. Applying backfill 22 may also make it easier for a cement truck to move close to cement form 12 for purposes of delivering the cement as part of the cement pouring process. An additional benefit of pre-filling the backfill 22 before pouring the cement is that most, if not all of the grading associated with the cement structure (e.g., foundation 24) may be completed prior to pouring the cement without requiring a further follow-up grading step.

Referring now to FIG. 4, the foundation 24 is shown with a building structure (e.g., wall 27) including a plurality of boards positioned along a top surface of the foundation 24. The connecting members 16 may be removed from connector groove 42 and reused in another cement form assembly. The stakes may be removed from stake openings 44, or may be driven further into stake openings 44 to be flush with weight bearing surface 38 or at least the top surface of backfill 22. In at least some examples, the connector groove 42 may be filled with a strip 46 (also referred to as insert 46). The strip 46 may comprise the same material as the rest of the cement form 12. In at least some examples, the strip may be the material that was removed from cement form 12 as part of forming connector groove 42. Strip 46 may fill connector groove 42 to limit the amount of material or other objects that may otherwise fill connector groove 42. Using the strip 46 within connector groove 42 may improve the aesthetics of the exposed portion of cement form 12. In other embodiments, connector groove 42 may be filled with other materials such as, for example, an expandable foam or other insulating material that is different than the material of cement form 12.

FIG. 5 shows another example cement form 112 that includes a plurality of stake openings 148, 149. The stake openings 148, 149 are shown arranged in two rows along the length of the cement form 112. The stake openings 148, 149 are spaced apart a distance  $X_2$  within each given row. The stake openings 148 may be offset from the stake openings 149 in the other row by a distance  $X_3$ . The stake openings 148 may be spaced from connector groove 142 a distance  $X_4$ . The rows of stake openings 148, 149 may be spaced apart a distance  $X_5$ . Each of the distances  $X_2$ ,  $X_3$ ,  $X_4$ ,  $X_5$  may be individually modified to provide a pattern or arrangement of stake openings 148, 149 on the cement form 112. Stake openings 148, 149 may also be positioned along a top surface 140 of the cement form 112. In other examples, additional or fewer rows and numbers of stake openings 148, 149 may be used.

The cement form 112 may be formed from any desired material. In at least some examples, the stake openings 144 are formed concurrently with forming the cement form 112 via, for example, a molding/forming process. In other examples, the stake openings 144 are formed in a separate step after the cement form 112 has been formed (e.g., using

a drilling, cutting, stamping or other method for removing material to create the stake openings 144).

FIG. 6 shows the cement form 212 embodiment that includes a plurality of support rib 250. The support ribs 250 may extend between a vertical portion 274 and a bottom or horizontal portion 276. A plurality of upper stake openings 248 may be included along an upper portion of the rib 250 or along a top surface 240 or other portion of the vertical portion 274. A plurality of lower stake openings 249 may be positioned along a weight bearing surface 238 and/or other portion of the horizontal portion 276. Other stake openings 244 may be positioned along other portions of ribs 250 or at other locations on cement form 212. The cement form 212 may include any desired number, arrangement, size, orientation and the like associated with the stake openings 248, 249. Furthermore, a cement form 212 may include any desired number, shape, size and orientation for the ribs 250. In at least some embodiments, cement form 212 may be void of the connector groove 242 and the ribs 250 may extend to top surface 240.

FIG. 7 illustrates another example cement form 312 having a hollow interior 352. The hollow interior 352 may be formed during formation of the cement form 312 such as, for example, during a molding process. Alternatively, hollow interior 352 may be formed after the cement form 312 has been formed using, for example, a coring, cutting, stamping, drilling, or other material removing process. Cement form 312 may include a plurality of upper and lower stake openings 348, 349. The stake openings 348, 349 may extend through the weight bearing surface 338 and the second surface 336.

Cement form 312 may also include a connector groove 342 and a first face 334. The hollow interior 352 may provide for a relatively constant wall thickness  $T_1$  that define each of the first and second surfaces 334, 336 and the weight bearing surface 338.

Cement form 312 is shown as a integrally formed, single piece. In other embodiments, cement form 312, along with other cement form embodiments disclosed herein, may comprise a plurality of parts that are separately formed and then later assembled together. In other embodiments, the cement form 312 may be formed as a wedge-shaped structure having a solid construction. In a later manufacturing step, portions of the wedge-shaped structure may be removed to form at least some of the features shown in FIG. 7. For example, the top surface 340 may be formed by cutting off a pointed edge of the wedge-shaped structure, the connector groove 342 may be formed by cutting out a portion of the solid structure, and the hollow interior 352 may be formed by removing an interior portion of the wedge-shaped structure. Many types of manufacturing processes and/or steps may be possible to form any one of the cement forms and associated cement form features disclosed herein.

Referring to FIG. 8, another example cement form 412 and inner insert 414 are shown and described. The cement form 412 does not include a connector groove as shown in the embodiments of FIGS. 1-7. The cement forms 412 may be interconnected with adjacent cement forms using other structures and/or devices as opposed to the connecting members 16 described above with reference to FIGS. 1-4. For example, adjacent cement forms 412 may be connected to each other with clips or brackets that attach to the weight bearing surfaces 438.

The cement form 412 and inner insert 414 may include a plurality of stake openings 444, 466, respectively. The cement form 412 may include a top surface 440, and the

inner insert **414** may include a top surface **468**. The stake openings may be formed in the top surfaces **440**, **468**. Alternatively, the stake openings **444**, **466** may be formed on other surfaces such as, for example, the weight bearing surface **438** and backfill support surface **464**, respectively. The stake openings may be pre-formed or formed concurrently as stakes are driven through the cement form **412** and inner inserts **414** and into a ground support. The cement form **412** and inner insert **414** may comprise materials that permit such forming of the stake openings as the stakes are driven through the structure of the cement form **412** and inner insert **414**.

The top surface **440** may provide a planer surface that provides an improved transition between cement form **412** and a top surface of a cement structure that is formed using the cement form **412**. In at least some examples, the cement structure is created to be flush with the top surface **440**. The inner insert **414** may include a top surface **468** to provide improved support of the resulting cement structure at the inner insert **414** as used to form and later support an underside surface of the cement structure. The top surface **468** may also provide improved ease of grading the backfill to the top edge of inner insert **414**. Providing the top surface **468** as at least a partial planer surface may reduce the chance of damaging the top edge of the inner insert **414** during the grading process.

FIGS. **9A-9D** show alternative cross-sectional shapes for the cement forms disclosed herein. For example, FIG. **9A** shows an L-shape having a vertical leg **554** and a horizontal leg **556**. The vertical leg **554** defines a first surface **534** that supports the cement structure during pouring of the cement, and a top surface **540**. A connector groove **542** may be formed in the top surface **540**. The horizontal leg **556** may define the second surface **536** as well as a weight bearing surface **538**. The vertical and horizontal legs **554**, **556** may have a substantially similar thickness, which may provide a constant R rating. The thicknesses of the vertical and horizontal legs **554**, **556** may provide sufficient structural rigidity to support the poured concrete. The cement form **512** may include a plurality of stake openings that are formed in, for example, the top surface **540** or the weight bearing surface **538**.

FIG. **9B** shows a cement form **612** having a vertical leg **654** and a horizontal leg **656**. A brace portion **658** may extend between the legs **554**, **556** to provide additional support there between. The use of brace portion **658** may make it possible to have a reduced thickness for the vertical and horizontal legs **654**, **656** because the brace portion **658** provides additional support and structural rigidity. The vertical leg **654** may define the first surface **634** and a top surface **640**. A connector groove **642** may be formed along the top surface **640** or along any other desired portion of the cement form **612**. The horizontal leg **656** may define the second surface **636** and the weight bearing surface **638**. A plurality of stake openings may be formed in, for example, the weight bearing surface **638** and/or the top surface **640**.

The brace portion **658** may extend in equal parts to the vertical leg **654** and the horizontal leg **656**. In other examples, the brace portion **658** may have a non-uniform, non-symmetrical construction. The brace portion **658** may extend along an entire length of the cement form **612**. In other embodiments, the brace portion **658** may be provided as rib features that extend along only portions of the length of the cement form **612**.

FIG. **9C** illustrates a cement form embodiment **712** having a semi-wedge shaped construction and a semi-block shaped construction. In one example, the cement form **712**

is formed from a block of material (e.g., foam material) that has a generally square shaped cross-section. A portion of the square shaped cross-section is removed. The removed portion may be the desired size for the inner insert **14**.

The cement form **712** has a greater thickness throughout that provides an improved R rating as compared to other embodiments such as the embodiments of FIGS. **9A**, **9B** and **9D**. The construction of cement form **712** may provide for an improved structural rigidity, stability while pouring the cement, and the like. The increased thickness may make it possible to use less dense and/or less rigid materials for the cement form **712** while still achieving the desired function of serving as a cement form and an insulating material.

Cement form **712** may include first and second surfaces **734**, **736** and a weight bearing surface **738**. A top surface **740** may extend along a top edge thereof. A connector groove **742** may be formed, for example, the top surface **740** and/or the weight bearing surface **738**. Cement form **712** may include a plurality of stake openings pre-formed therein. In at least some examples, cement form **712** may comprise of materials that permit concurrent forming of a stake opening as the stake is driven through the material of the cement form **712**.

FIG. **9D** illustrates another example cement form **812** that has a right angle, triangular shape with two legs having equal lengths. The generally symmetrical shape of cement form **812** may make it possible to form two cement forms **812** from a single block of material having a square cross-sectional shape, while maintaining equal lengths for each of the first and second surfaces **834**, **836**. A connector groove **842** may be formed in a weight bearing surface **838**. The cement form **812** may be void of a generally planer top surface as is included in other embodiments disclosed herein. Cement form **812** may include a plurality of pre-formed stake openings formed therein, or may comprise materials that permit concurrent formation of stake openings as stakes are driven through the material of cement form **812**.

Many other triangular shapes are possible for the cement form **812** by modifying the relative lengths between surfaces **834** and **836**. Maintaining a right angle relationship between surfaces **834**, **836** may be a constant feature among all of the various triangular shapes that are possible. The triangular shape of the cement form **812** may provide improved stacking of cement forms for purposes of storage, shipping, etc. Providing cement forms **812** having mirrored shapes maximizes storage space and may provide compact, efficient storage and/or shipping. Other designs disclosed herein provide similar benefits including, for example, the cement form **712** and inner insert **14** shown in FIG. **9C**.

FIGS. **10A-10C** show steps of manufacturing a pair of cement forms **12** in accordance with the present disclosure. FIG. **10A** shows a block of material **80** having a rectangular cross-sectional shape. The rectangular shape having a slightly greater width  $W_4$  than height  $H_4$  makes it possible to maintain equal dimensions for the resulting first and second surfaces **34**, **36** of each cement form **12** while also providing a flat top surface **40** for each of the cement forms **12**. Other embodiments may include use of a block of material **80** having a square shaped cross-section and provide the same or similar benefits.

FIG. **10A** shows a cut line **82** that is used to cut the block in half to create two separate cement forms **12** as shown in FIG. **10B**. After the cement forms **12** are separated, connector grooves **42** may be formed with cuts **84**. FIG. **10C** shows removable strips **46** taken from connector groove **42** as a result of cuts **84**. The strip **46** may be removed to make room

for a connecting member such as connecting member 16 described with reference to FIGS. 1-4. The strip 46 may be replaced in connector groove 42 after removing connecting member 16 (e.g., after the cement structure has been formed) so that the connecting members can be used with a different cement form assembly. The connecting members can be reused for different cement pouring projects and the strips 46 may be used to fill connector groove 42 to prevent unwanted objects from entering connector groove 42 and to help maintain a desired R value for cement form 12.

The forming method described with reference to FIGS. 10A-10C is particularly useful when the material of block 80 comprise a foam material such as those foam materials described herein. However, other materials may be used such as, for example, polymer materials or other insulating materials. Using just three cuts (cuts 82 and two cuts of 84), two separate cement forms may be formed from a single block of material and at relatively low manufacturing and material cost. In embodiments in which the cement forms 12 do not require a connector groove, a single cut 82 through block 80 may result in two completed cement forms 12 that are ready for use.

FIG. 11 shows two cement forms 12 positioned end-to-end in a top view. A connecting member 16 is positioned within connector grooves 42 of the adjacent cement forms 12. The connecting member 16 spans the two cement forms 12. Typically, the cement forms 12 are positioned end-to-end in alignment with each other such that the connector grooves 42 are in alignment with each other. The connecting member 16 is then positioned within the connector groove 42.

A single connecting member 16 may span multiple cement forms 12 such as three or more cement forms. In some arrangements, the connecting member 16 has a length that is substantially the same as the length  $L_1$  of cement form 12. Positioning a plurality of connecting members 16 end-to-end within the connector grooves of a plurality of aligned cement forms 12 may completely fill the connector grooves of all of the cement forms. In other examples, a relatively short cement form may be used within the connector groove 42 at or adjacent at the mating first and second ends 30, 32 of adjacent positioned cement forms 12 as shown in FIG. 11. The connector groove 42 may have a length that is customized for a particular length connecting member 16.

In other embodiments, the adjacent position cement forms 12 may be interconnected with different structured connecting members providing different functions. For example, the connecting members may include claws or barb features that grasp the material of the cement forms 12 without the need for a pre-forming groove or other apertures sized to receive the claw/barb features.

FIGS. 12A-12E illustrate alternative embodiments for inner inserts used with the cement form assemblies described herein. FIG. 12A shows an inner insert 514 having a wedge-shaped construction with a contoured top surface 568. The contoured upper edge (also referred to as a top surface 568) may provide a reduced stress point in the resultant cement structure that is supported by and/or formed around the inner insert 514. The surface 568 may have any desired radius and may extend between the cement surface 560 and the backfill support surface 564. In some embodiments, other edges of the inner insert 514 may have curvature such as, for example, the edge formed at the intersection between ground support surface 562 and backfill support surface 564.

FIG. 12B shows an inner insert 614 having an upper surface 668 defined between the cement surface 660 and the backfill support surface 664, and a planer edge surface 670

defined between the ground support surface 662 and backfill support surface 664. Removing the pointed edges that are otherwise included in place of the surfaces 668, 670 may reduce the propensity of the sharp edges to break off or be deformed/damaged during manufacture, shipping, storage and installation of a cement form assembly at a construction site.

FIG. 12C shows an inner insert 714 having a contoured shape for the cement surface 760. The contoured shape of cement surface 760 may reduce the incidence of stress concentration points at the inner/lower surface of the cement structure (e.g., monolithic foundation). The inner insert 714 may have any desired shape and size for the cement surface 760, including a contoured portion, a combination of linear and contoured portions, and the like. In some embodiments, the backfill support surface 764 may be arranged at a non-vertical orientation thereby reducing the amount of material needed for the inner insert 714. Typically, the ground support surface 762 remains flat or planer to provide a desired interface with the ground support.

FIG. 12D shows an inner insert 814 having a hollow interior 872. The hollow interior may be formed concurrently with formation of the remaining portions of the inner insert 814. Alternatively, the hollow interior 872 may be formed after formation of the inner insert 814 structure. A boring, cutting, stamping, or other manufacturing step may be used to create the hollow interior 872.

The resulting sidewalls of the inner insert 814 may have a generally constant thickness associated with the cement surface 860, ground support surface 862 and backfill support surface 864. The hollow interior feature may be used in any of the inner insert embodiments shown with reference to FIGS. 12A-12E and other embodiments possible in accordance with the present disclosure. In some arrangements, the hollow interior 872 mirrors the outer peripheral shape cross-sectional shape of the inner insert 814. In other embodiments, the hollow interior may have a shape that is different from the perimeter shape such as, for example, a generally circular shape interior 872 used with the triangular shape outer periphery of inner insert 814.

FIG. 12E shows an inner insert embodiment 914 having an equilateral triangular shape with a truncated upper corner of the triangle. The truncated upper portion defines a top surface 968. A top surface 968 may provide the desired improved grading to the top of the inner insert 914 with reduced chance of damaging the top surface 968. The tapered shape of cement surface 960 may provide improved strength and limited stress concentration along the inner, bottom surface of the cement structure (e.g., monolithic foundation). The ground support surface 962 has a generally planer construction. The backfill support surface 964 may mirror the tapered or angled orientation of the cement surface 960. Other variations of the wedge-shaped, triangular-shaped construction of the inner insert 914 are possible wherein different lengths, angled orientations, truncation locations, and the like are provided.

The apparatuses and methods disclosed herein provide numerous advantages as compared to the traditional cement form structures and related methods of forming cement structures such as monolithic cement foundations described above with reference to FIGS. 13A and 13B. For example, the apparatuses and methods disclosed herein provide a reduced cost solution for at least the reason that the required man hours is significantly reduced for setting up cement forms for pouring a cement structure, such as a monolithic cement foundation. Further, the apparatuses and methods disclosed herein provide for improved insulation of a cement



structure such as the monolithic cement foundation. The man hours required to install the insulation material is possibly non-existent since the cement forms themselves may include insulating material and be left in the ground after pouring the cement structure and covered to provide the insulating function.

At least some of the methods of manufacturing disclosed herein may provide for improved ease in creating the cement forms. The structure of the cement forms may provide improved storing, shipping, and handling with increased efficiency. Still further, at least some of the materials possible for use in the cement forms (e.g., foam materials) are significantly lighter weight than traditional cement forms. As a result, the cost of shipping and the amount of effort and/or energy required in maneuvering these cement forms of the present disclosure is significantly reduced thereby increasing the overall efficiency for using the cement form assemblies disclosed herein. Further, the use of foam as a primary material for the cement forms provides for a lighter weight object to be manually maneuvered at a work site, which may provide reduced incidence of workplace injuries such as back strains, pulled muscles, foot or leg crushing/bruising, and the like due that may otherwise occur when using traditional material for the cement forms.

Another advantage related to using foam or polymer materials as the primary (if not exclusive) material for the cement form is that such materials typically do not absorb moisture from the cement as the cement cures. Avoiding moisture absorption leads to improved consistency in how the cement cures as compared to using other materials for the cement forms such as wood. Wood cement forms have a high rate of moisture absorption, and are typically sprayed with a petroleum product such as diesel fuel just prior to pouring the cement in an effort to limit the moisture absorption properties of the wood. An improved consistency in how the cement cures may lead to reduced incidence of later cracking in the cement structure.

A further advantage relates to the ability to backfill around and/or over the cement forms prior to pouring cement. The pre-backing filling (i.e., prior to pouring cement) makes it possible to have excavation equipment on site just for digging and set up of the cement forms (i.e., the equipment does not have to return after pouring cement and removing the cement forms according to traditional methods), thereby decreasing costs and overall time for completing formation of a cement structure such as a monolithic foundation. Increasing the speed of forming a cement foundation typically results in an over decrease in the overall time for completion of a construction project, which leads to reduced costs and improved efficiencies. Providing a backfill prior to pouring also may involve grading the ground surface surrounding the cement forms. A graded surface may improve safety for workers during pouring of cement because the workers can work on a graded rather than having to work on uneven surface and/or working around kickers, stakes and brace boards as is required in traditional methods.

The present description provides examples, and is not limiting of the scope, applicability, or configuration set forth in the claims. Thus, it will be understood that changes may be made in the function and arrangement of elements discussed without departing from the spirit and scope of the disclosure, and various embodiments may omit, substitute, or add other procedures or components as appropriate. For instance, the methods described may be performed in an order different from that described, and various steps may be

added, omitted, or combined. Also, features described with respect to certain embodiments may be combined in other embodiments.

Various inventions have been described herein with reference to certain specific embodiments and examples. However, they will be recognized by those skilled in the art that many variations are possible without departing from the scope and spirit of the inventions disclosed herein, in that those inventions set forth in the claims below are intended to cover all variations and modifications of the inventions disclosed without departing from the spirit of the inventions. The terms "including:" and "having" come as used in the specification and claims shall have the same meaning as the term "comprising."

What is claimed is:

1. A cement form to support a volume of cement during formation of a monolithic building foundation, the cement form configured to remain in place after formation of the building foundation to provide insulation for the building foundation, the cement form comprising:

- a single piece, unitary body member having a solid, continuous construction and a single wedge-shaped cross-section, the body member comprising:
  - a first surface arranged vertically and configured to support a volume of cement;
  - a second surface arranged horizontally at a right angle to the first surface and configured to contact a ground support surface, the second surface extending continuously along a length of the cement form;
  - a weight bearing surface extending diagonally relative to the first surface and the second surface;
  - a connector groove formed in the weight bearing surface and open in a vertically upward direction, the connector groove being configured to receive a connecting member that extends between and interconnects adjacent positioned cement forms;
  - a foam material;
  - a top surface extending from the first surface toward a plane of the weight bearing surface and intersecting with the connector groove, the top surface defining an upper most point of the body member, the first surface extending continuously from the second surface to the top surface to define a height of the body member, the connector groove extending along less than half of the height;
  - at least one connecting member removably positioned vertically in the connector groove and configured to interconnect with an adjacent body member;
  - a plurality of support stakes extending through the body member and into a ground support; and
  - at least one inner insert spaced from the body member and arranged to be positioned under a cement structure formed using the cement form, the at least one inner insert having a wedge cross-sectional shape and a single-piece, solid, continuous construction, the at least one inner insert being formed solely of foam material.

2. The cement form of claim 1, wherein the body member has the wedge cross-sectional shape along the entire length.

3. The cement form of claim 1, wherein the body member has a triangular cross-section shape.

4. The cement form of claim 1, wherein the connector groove extends along at least a portion of the length of the body member.

5. The cement form of claim 1, further comprising at least one aperture sized to receive a support stake extending through the body member.

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6. A cement form to support a volume of cement during formation of a monolithic building foundation, the cement form configured to remain in place after formation of the building foundation to provide insulation for the building foundation, the cement form comprising:

an elongate member having a solid, continuous construction with a wedge cross-sectional shape along an entire length of the cement form, the elongate member being formed in its entirety from a single foam material, the elongate member comprising:

first and second surfaces, the first surface being arranged perpendicular to the second surface;

a third surface extending diagonally relative to the first surface and the second surface;

a connector groove formed in the third surface and extending along a length direction of the elongate member, the connector groove being configured to releasably receive a connecting member used to interconnect adjacent positioned cement forms, the connector groove being open in a vertical direction;

a top surface extending perpendicularly from the first surface toward a plane of the third surface and intersecting with the connector groove, the top surface defining an upper most point of the elongate member, the first surface extending continuously from the second surface to the top surface;

wherein a height of the elongate member being defined by the first surface from the second surface to the top surface, and a width being defined by the second surface from the first surface to the third surface, the elongate member having a greater width than height;

at least one connecting member removably positioned vertically in the connector groove and configured to interconnect with an adjacent elongate member;

a plurality of support stakes extending through the elongate member and into a ground support; and

at least one inner insert spaced from the elongate member and arranged to be positioned under a cement structure formed using the cement form, the at least one inner insert having a wedge cross-sectional shape and a single-piece, solid, continuous construction, the at least one inner insert being formed solely of foam material.

7. The cement form of claim 6, wherein the elongate member is configured to be at least partially covered with backfill dirt prior to forming a cement structure using the elongate member.

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8. The cement form of claim 6, wherein the first surface is arranged vertically and configured to support a volume of cement, and the second surface is arranged horizontally and configured to contact a ground support surface, the first and second surfaces being continuous along the length of the elongate member.

9. The cement form of claim 6, wherein the foam material includes at least one of expanded polyethylene and high density foam.

10. A cement form assembly to support a volume of cement during formation of a monolithic building foundation, members of the cement form assembly configured to remain in place after formation of the building foundation to provide insulation for the building foundation, the cement form comprising:

at least two cement forms each comprising:

first and second surfaces, the first surface being arranged perpendicular to the second surface;

a third surface extending diagonally relative to the first surface and the second surface;

at least one connector groove formed in the third surface and extending along an entire length of the cement form, the at least one connector groove being open in a vertically upward direction;

a single wedge cross-sectional shape;

a single-piece, solid, continuous construction formed solely of a single foam material;

at least one connecting member removably positioned vertically in the connector grooves and spanning between the at least two cement forms to interconnect the at least two cement forms;

a plurality of support stakes extending through the at least two cement forms and into a ground support; and

at least one inner insert spaced from the at least two cement forms and arranged to be positioned under a cement structure formed using the cement form, the at least one inner insert having a wedge cross-sectional shape and a single-piece, solid, continuous construction, the at least one inner insert being formed solely of foam material.

11. The cement form assembly of claim 10, wherein the at least two cement forms each have the wedge cross-sectional shape along the entire length of the cement form.

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